SOIL SURVEY

Saline County Kansas

OUR SOIL ★ OUR STRENGTH

Series 1950, No. 4

Issued January 1959

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
KANSAS AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS SURVEY of Saline County will help you plan the kind of farming that will protect your soils and provide good yields. It describes the soils; shows their location on a map; and tells what they will do under different kinds of management.

FIND YOUR FARM ON THE MAP

In using this survey, start with the soil map. This map consists of six folded sheets in the jacket containing this report. The index on the bottom margin of each sheet shows you where each sheet is located. Find your farm by using township and section lines. Then locate the soils on the farm in relation to roads, streams, dwellings, and other landmarks. You will notice boundaries of the soils have been outlined in black and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you have found on your farm an area marked with the symbol El. You learn the name of the soil this symbol represents by looking at the map legend. The symbol El identifies Edalgo silt loam, 2 to 6 percent slopes.

LEARN ABOUT THE SOILS ON YOUR FARM

Edalgo silt loam, 2 to 6 percent slopes, and all other soils mapped are described in the section Soils of Saline County. Soil scientists, as they walked over the fields and other land areas of the county, described and mapped the soils; dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they had mapped and studied the soils, the scientists judged what management each soil should have when used for crops or native pasture. They then placed it in a management group and a range site. Edalgo silt loam, 2 to 6 percent slopes, is in management group 2A and in the clay upland range site. Turn to the section Use and Management of the Soils and read what is said about the soils of these groups.

You will want to study table 7, which tells you how much you can expect to harvest from Edalgo silt loam, 2 to 6 percent slopes, under two levels of management. In columns A are yields to be expected under common practices, and in columns B are yields to be expected under improved management.

MAKE A FARM PLAN

For the soils on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of your State experiment staff and others familiar with farming in your county will also be glad to help you.

This publication on the soil survey of Saline County, Kansas, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE
and
KANSAS AGRICULTURAL EXPERIMENT STATION

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SOIL SURVEY OF SALINE COUNTY, KANSAS

By A. J. CLINE, in Charge, JAMES T. NEILL, and ORVILLE W. SAFFRY, Soil Survey[1], Soil Conservation Service, United States Department of Agriculture, and PAUL L. BROWN and DAROLD A. DODGE, Kansas Agricultural Experiment Station.

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United States Department of Agriculture in Cooperation with the Kansas Agricultural Experiment Station

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

SALINE COUNTY is located in the central part of Kansas (fig. 1). The area of the county is approximately 720 square

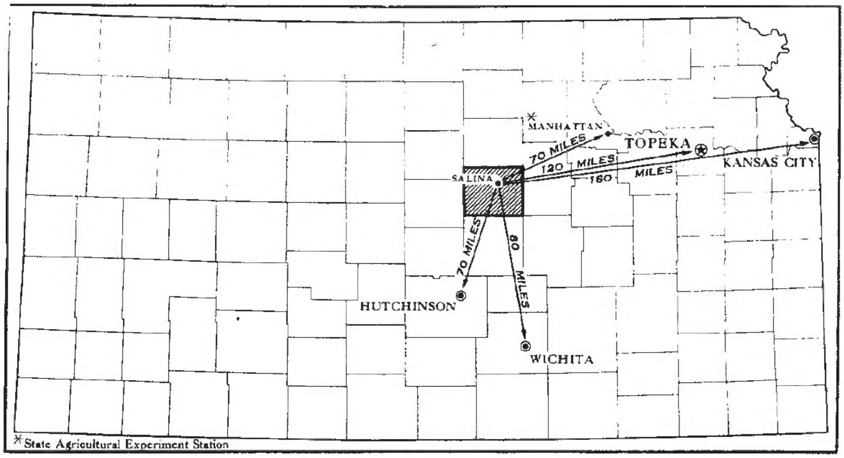


Figure 1.—**Location of Saline County in Kansas.**

miles, or 460,800 acres. Salina, the county seat, is 160 miles west of Kansas City; 120 miles west of Topeka, the State capital; 70 miles west of Manhattan, the location of the State Agricultural Experiment Station; 80 miles north of Wichita; and 70 miles north of Hutchinson.

Agriculture is the dominant enterprise in Saline County. Wheat, sorghum, and alfalfa are the principal crops. Beef cattle and sheep are grazed in the upland areas, largely in the western part of the county. Industry in the county is related to agriculture and is located mostly in Salina, the chief distribution center in north-central Kansas. Fieldwork for the survey was completed in 1949, and, unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

[1] Fieldwork for this survey was done while Soil Survey was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Saline County lies partly within the Great Plains Province and partly within the Central Lowland Province of the Interior Lowland region. The boundary between the two provinces roughly divides the county into halves.

The western half of the county lies within the eroded zone along the eastern edge of the High Plains. It consists of steeply rolling hills and ridges separated by relatively narrow and deep stream valleys. The upland areas among the headward eroding streams are remnants of the alluvial plain that once spread from the mountains in the west to the Central Lowland. Progressing eastward toward the more maturely dissected central part of the county, the ridges are lower and partially dissected into low mesalike hills with cone-shaped bases and rounded tops. Elevations in this part of the county range from 1,680 feet near the western county line to 1,280 feet near the terraces along the Smoky Hill River in the central part of the county.

The eastern part lies within the smoother, gently rolling Central Lowland Province. In general character this area is a plain of low relief, but two parts have greater relief than normal—the hills east of the Smoky Hill River, and the divide between the Smoky Hill River and Gypsum Creek. The hills east of the Smoky Hill River are composed of wind-deposited materials from the valley floor. The divide between the Smoky Hill River and Gypsum Creek consists of erosion remnants similar to those in the western part of the county. Elevations in the eastern part of the county range from 1,520 feet in the south-central part to 1,200 feet in the northeastern part.

The county is drained by three large rivers and four major intermittent streams. The Smoky Hill River is the largest stream. It enters from the south, flows north to the vicinity of Salina, and then follows an easterly course until it leaves the county. The Saline River enters the county from the north and flows southeastward until it empties into the Smoky Hill River east of Salina. The Solomon River flows across the northeastern corner of the county to its junction with the Smoky Hill River near the county line. Broad, gently sloping terraces border these rivers. In addition to the rivers, three intermittent streams—Mulberry, Spring, and Dry Creeks—and their tributaries drain the western part of the county. These streams rise in the steeply rolling areas and flow east and northeast to the Saline River. The southeastern and eastern parts of the county are drained by Gypsum Creek and its tributaries, another intermittent stream which flows northward to the Smoky Hill River. Since this stream receives runoff from a large area, it sometimes reaches flood stage. When this occurs, farmlands along the length of the valley are subject to flooding.

CLIMATE

Saline County has a subhumid continental type of climate that is characterized by hot summers and moderately cold winters. Table 1 shows the normal monthly, seasonal, and annual temperature and precipitation at Salina. Temperature extremes vary

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Salina, Saline County, Kansas*

[Elevation, 1,225 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year 1910	Wettest year 1951	Average snowfall
	° F.	° F.	° F.	*Inches*	*Inches*	*Inches*	*Inches*
December	32.9	81	−15	0.79	0.19	0.23	3.7
January	30.1	75	−28	.67	1.16	.40	3.6
February	33.9	84	−31	1.00	.16	1.19	5.2
Winter	32.3	84	−31	2.46	1.51	1.82	12.5
March	44.4	96	−11	1.37	(3)	1.53	3.8
April	55.6	98	5	2.52	1.33	2.50	1.5
May	64.8	106	19	3.90	4.67	6.22	(3)
Spring	54.9	106	−11	7.79	6.00	10 25	5.3
June	75.0	114	38	4.53	1.38	12.49	(3)
July	80.8	116	46	3.25	1.12	10.72	(3)
August	80.0	118	38	3.26	4.73	3.59	0
Summer	78.6	118	38	11.04	7.23	26.80	(3)
September	71.1	110	28	2.74	1.98	8.51	0
October	59.1	98	14	1 97	.08	2.02	.3
November	44.4	84	−4	1.17	.09	.26	1.0
Fall	58.2	110	−4	5 88	2.15	10.79	1.3
Year	56.0	118	−31	27.17	16.89	49.66	19.1

[1] Average temperature based on a 54-year record, through 1952; highest and lowest temperatures on a 58-year record, through 1952.
[2] Average precipitation based on a 69-year record, through 1952; wettest and driest years based on a 69-year record, in the period 1883-1952; snowfall, based on a 57-year record, through 1952.
[3] Trace.

from 118° F. to −31° F. The average annual temperature, based on a 54-year record, is 56° F. Daily temperature changes are often abrupt and sometimes relatively great. The growing season at Salina is 174 days. The average date of the last killing frost in spring is April 23, and that of the first killing frost in autumn is October 14. The latest and earliest dates of killing frost during the 40 years on record were May 27 and September 13, respectively.

The average precipitation at Salina, based on a 69-year record, is 27.17 inches. Nearly 70 percent of this amount falls during the frost-free period. However, the seasonal and monthly distribution of precipitation are both very variable. The decrease in precipitation during the latter part of the growing season and the relatively high rates of evaporation at this time of year cause

periods of drought that are injurious to crops. The driest year in recent records was 1936, when 17.72 inches of precipitation were recorded. Intense rainfall during short intervals of time are common. The prevailing winds are from the west and southwest. Highest wind velocities normally occur during March, April, and May.

WATER SUPPLY[2]

Ground water supplies in Saline County are ample for domestic and commercial uses, but the hardness of the water varies greatly in different localities. The western and north-central parts of the county and the area between the Smoky Hill River and Gypsum Creek are underlain by fine-textured Kiowa shale and sandstone beds of Cretaceous age. The shales are poor sources of water, but the sandstone strata usually yield large flows of water of excellent quality. The average depth of the wells is about 40 feet; their flow is consistent throughout the year. Springs frequently occur where the sandstone strata are exposed along the valley slopes. These springs provide water for pastures and can be used as a source of water for stock.

In the eastern part of the county ground water is obtained from beds of the Wellington formation that are Permian in age. These beds, which consist of fine-textured shales and interbedded limestone strata, are poor sources of ground water. Wells terminating in the shale beds frequently have poor yields and are apt to run dry during periods of drought. In addition, the water derived from these wells is extremely hard and may even be brackish. It is seldom used for human consumption; farms and ranches depend heavily upon cisterns for household supplies of drinking water. The wells average 30 to 40 feet in depth and usually supply water for stock. Wells that penetrate through the shale to the deeper interbedded or underlying limestone strata supply larger amounts of better quality water.

In the valleys of the Saline, Solomon, and Smoky Hill Rivers, ground water is plentiful and easily obtained, but it is moderately hard. The wells are dug through the silts and clays of the terraces to the water-bearing beds of sand and gravel beneath. They vary from 20 to 40 feet in depth. Depth to the water-bearing strata decreases as the river is approached. The city of Salina obtains its water supplies from this source.

Ground water supplies for irrigation purposes are ample in some areas. In other areas the major streams are potential sources of good irrigation water. Since the completion of Kanopolis Dam (Ellsworth County), the flow of water in the Smoky Hill River is regular and reliable. According to the 1954 census, there were 28 irrigated farms and 2,133 acres of land under irrigation.

ORGANIZATION AND POPULATION

The first permanent settlement in Saline County was made in 1858 at the present site of Salina. The county was organized in

[2] LATTA, BRUCE F. GROUND-WATER CONDITIONS IN THE SMOKY HILL VALLEY IN SALINE, DICKINSON, AND GEARY COUNTIES, KANSAS. Univ. of Kansas publications, State Geological Survey of Kansas, Bul. 84, 152 pp., illus. 1949.

1859 by an act of the legislature, at which time commissioners were appointed to establish the boundaries. Growth was very slow during the Civil War years, but with the end of the war, and the building of the Kansas Pacific Railroad in 1867, the rate of settlement increased. By 1870 the county had a population of 4,246. In 1950 the population was 33,409, and of this number, 26,176 persons, or 78.4 percent of the total population, lived in the city of Salina.

INDUSTRIES

Salina is the largest city in north-central Kansas and the industrial center of the county. Much of its industrial development involves the processing of agricultural products. Salina is one of the larger grain-milling centers in the United States. The drying of alfalfa meal is an industry that has developed rapidly since World War II and is becoming increasingly important in the agriculture of the county. There are several creameries, produce houses, and packing plants that process and sell livestock products. In addition Salina is a center for the sale of live hogs and cattle. It is also the headquarters for many small industries and enterprises in this section of Kansas.

TRANSPORTATION AND MARKETS

Salina, the county seat, is the major marketing and industrial center in the county. Both United States Highway 81, which crosses the State in a north-south direction, and United States Highway 40, which crosses the State in an east-west direction, pass through Salina. They provide direct routes from Salina to Topeka, Kansas City, Hutchinson, and Wichita. The interstate highways are easily reached from all parts of the county over the serviceable network of section-line roads and, in the southeastern part, by State Highway No. 4.

Three railroads, the Union Pacific, Missouri Pacific, and Atchison, Topeka, and Santa Fe, provide direct rail service to Salina. The Rock Island Line provides an auto-rail connection service with its main line at Herington, Kansas.

CULTURAL DEVELOPMENT

Since World War II new equipment and new conveniences have made life on the American farm much easier and more enjoyable. In Saline County rural electrification has eliminated much of the work once done by hand, or by expensive and bulky gasoline engines. Electrical appliances have eased the chores of the farm home and provided more free time. Radio and television provide a medium of education and communication vital to progress in agriculture.

Education, too, has been improved in many places by the consolidated school. Where rural schools are maintained, they are better equipped and more adequately staffed than in the past.

Medical facilities and services are more available to all the residents in the county. There are two hospitals and three clinics. The county maintains a health service, and similar services are provided by the State.

Since the completion of Kanopolis Dam in Ellsworth County, various water sports have been available within easy driving distance. Smaller lakes and recreational areas are being established for community and private use, and many farm ponds are being stocked with fish. Civil-sponsored farm and community gatherings are promoting a better community spirit and providing new educational and recreational benefits for the people of the area.

AGRICULTURE

Table 2 shows the number of farms, average size of farms, and land in farms in stated years. In 1954, 98.5 percent of the approximate land area, or 453,851 acres, was in farms. The trend in recent years has been toward fewer and larger farms and, in some parts of the county, toward a more diversified type of farming.

TABLE 2.—*Number of farms, average size, and land in farms*

Year	Farms	Average size	Land in farms	Proportion in farms	Proportion of improved farm land
	Number	*Acres*	*Acres*	*Percent*	*Percent*
1930	1,839	248.6	457,221	99.2	65.5
1940	1,667	248.4	414,137	89.9	69.3
1950	1,277	305.2	389,686	84.6	68.3
1954	1,212	374.5	453,851	98.5	58.0

CROPS

The acreages of principal crops in stated years are shown in table 3. Wheat is the chief crop in the county. In 1954, wheat accounted for 59.2 percent of the acreage in principal crops and 90.8 percent of the acreage in small grains. Sorghum and hay crops, in nearly equal proportion, made up 28.1 percent of the acreage in principal crops. Corn, alfalfa for seed, and soybeans were grown on most of the remaining acreage in crops. Wheat is the most important crop in the county, but a downward trend in wheat acreage is indicated in table 3. This trend may be explained in part by recent trends in farming in the western third of the county, where the number of cash wheat farms is decreasing and dependence upon livestock for income is increasing.

Wheat.—Wheat, the most important cash crop, is grown on most soils, but the areas of intensive production are the alluvial soils of river valleys and on the deeper loess soils in the central and eastern parts of the county.

Wheat of the winter varieties is grown. The best yields are usually obtained by plowing the land as soon as possible after the last crop is removed. Early plantings, between September 25 and October 10, assure better root development and reduce winter-killing. The crop is harvested almost entirely by combines and sold at local elevators soon after harvest. In recent years a percentage of the crop has been stored on the farms.

TABLE 3.—*Acreage of principal crops in stated years*

Crop	1929	1939	1949	1954
	Acres	*Acres*	*Acres*	*Acres*
Corn for all purposes	45,255	12,945	8,750	7,308
Harvested for grain	33,454	1,237	5,652	266
Cut for silage	3,949	3,071	1,597	4,640
Hogged or grazed, or cut for green or dry fodder	7,852	8,637	1,501	2,402
Sorghums for all purposes except sirup	12,183	24,777	14,173	31,770
Harvested for grain or for seed	6,354	1,784	4,114	8,688
Cut for silage	5,829	3,550	3,390	6,227
Hogged or grazed, or cut for dry forage or hay	(1)	19,443	6,669	16,855
Small grains threshed or combined	179,407	171,671	178,982	140,533
Wheat	174,177	157,145	170,803	127,713
Oats	[2] 4,815	6,481	5,444	8,071
Barley	408	7,312	1,300	3,448
Rye	7	341	162	613
Other small grains grown alone or together	(1)	392	1,273	688
Soybeans grown for all purposes	12	(1)	30	1,313
Hay crops, excluding soybeans and sorghum hay	14,319	7,923	18,144	28,867
Alfalfa and alfalfa mixtures cut for hay (and for dehydrating)	8,569	3,516	12,893	22,761
Clover, timothy, and mixtures of clover and grasses cut for hay	33	15	162	119
Small grains cut for hay	29	422	294	556
Wild hay cut	4,720	2,945	3,738	4,554
Other hay cut	960	1,002	862	575
Alfalfa, clover, bromegrass, and other seed crops	965	1,196	4,784	5,763

[1] Not reported.
[2] Includes 216 acres of oats cut and fed unthreshed.

Corn.—The acreage planted in corn has decreased steadily during the last 24 years. Today very little corn is grown for grain; the greater part of the crop is used for feeding livestock. The crop is grown almost entirely on the soils in stream valleys. Since prolonged periods of hot, dry weather during the tasseling stage often prevent pollination, plantings are staggered over several weeks and hybrid varieties differing in time of maturity are usually grown in the same field. Production of corn is confined almost entirely to the deep, friable, fertile soils of the stream valleys.

Sorghum.—Sorghum ranks second to wheat in total acreage. Much of the crop is used for forage, but the demand for sorghum grain for commercial use and as livestock feed is increasing. The crop is hardy and grows on soils where the fertility is seriously depleted. For this reason the crop is grown on badly eroded and shallow soil areas following wheat. The planting date is usually between May 25 and June 20.

Alfalfa.—Alfalfa is grown for hay, seed, and dehydrating, principally in the river valleys. On upland soils yields are poorer and it is often difficult to maintain the stand. Alfalfa is a soil-building crop; its deep roots penetrate the heavy subsoils and claypans and bring plant nutrients nearer to the surface layer. When used for green manure, alfalfa increases the supply of available nitrogen. For best growth, many of the soils in the county require applications of phosphorus fertilizer when alfalfa is grown. The soils developing on sandstone and shale parent materials also require additions of lime.

In preparing the seedbed for alfalfa, the soil usually is plowed in the spring and left fallow until late in August to increase the supply of moisture. The planting date is between August 15 and September 5. Fertile bottom-land soils are sometimes plowed following wheat harvest and, if kept free of weeds during the intervening period, are planted to alfalfa in August.

Sweetclover.—Sweetclover is used as a soil-building crop in the uplands where alfalfa is not as well suited to the soils. If properly inoculated, it adds more nitrogen to the soil during its short period of growth than any other crop. It can be grown more easily than alfalfa on shallow, rocky, and claypan soils and is more tolerant of poorly drained and droughty soils.

Sweetclover is seeded between March 1 and April 15 in the spring or between August 10 and August 31 in the fall. On sandy soils the crop is often sown in sorghum cover or sorghum stubble. The seed is sown with press-wheel drill, and the soil is packed afterward to firm the seedbed. On clean-tilled sandy soils, sweetclover is often seeded in wide-spaced rows of oats. The ground is packed before planting the sweetclover and oats.

Oats.—Oats are seeded in the spring, often as a replacement crop where stands of wheat are poor or where wheat has been winterkilled. For this reason, the acreage planted fluctuates from year to year. The crop is not suited to some of the imperfectly and poorly drained heavy clay soils in the county. Oats feed heavily on soil nitrogen but tend to lodge when the supply of nitrogen is excessive. The crop should not be grown immediately after turning under a green-manure crop on soils that are normally high in available nitrogen. Since the crop does not feed so heavily on phosphorus as wheat, it is a good second-year crop on a field where a legume has been turned under. The best seeding time is between March 1 and March 15.

Barley.—Both winter and spring barley are grown in the county. Winter barley is planted about the same time as wheat on summer-fallowed land. Spring-sown barley, like oats, is used as a replacement crop for wheat that failed, but barley is easily damaged by hot humid weather in the spring and early in summer. Barley is not as well suited to poorly drained soils as wheat and is less tolerant of nitrogen and phosphorus deficiencies. It is sensitive to moderate degrees of acidity but is tolerant of moderate accumulations of alkali and soluble salts. Barley is generally planted in summer-fallowed land between September 20 and October 10. Spring barley is generally planted between March 5 and March 25.

PERMANENT PASTURE

In 1954, 15,060 acres of cropland were used for pasture. Nearly 171,495 acres were in permanent pasture. The acreages in permanent pasture are on soils that are shallow, rocky, infertile, or unsuited to grain farming in some other way. The largest areas of permanent pasture are in the western third of the county.

LIVESTOCK AND LIVESTOCK PRODUCTS

Saline County is primarily a wheat-producing area, but recently there has been an increase in the number of livestock in the county. Income derived from the sale of livestock and livestock products is helping to build a more stable agricultural economy. Most beef cattle and sheep are raised in the western part of the county. Dairy herds are more numerous around the city of Salina and small population centers where milk and dairy products can be marketed daily. Table 4 shows the number of livestock on farms in stated years.

TABLE 4.—*Livestock of all ages on farms*

Livestock	1930	1940	1950	1954
	Number	*Number*	*Number*	*Number*
Cattle	37,248	[1] 29,474	31,638	40,114
Cows milked	6,014	[2] 6,970	5,078	4,003
Horses and mules	8,582	[1] 3,790	1,565	725
Hogs	19,953	[3] 3,659	6,384	4,685
Sheep	2,284	[4] 2,261	1,359	1,711
Chickens	[1] 264,506	[3] 145,662	[3] 115,105	[3] 113,760
Turkeys raised	[2] 1,846	18,223	2,052	7,637
Ducks raised	[2] 1,855	571	603	740

[1] Over 3 months old.
[2] One year earlier than year given at head of column.
[3] Over 4 months old.
[4] Over 6 months old.

LAND USE, AND SIZE AND TYPE OF FARMS

In 1954, crops were harvested on 46.3 percent of the land in farms. About 11.5 percent of the farmland was used for pasture, fallowed, or left idle. Land in permanent pasture made up a large proportion of the 453,851 acres of farmland. Land use data for 1954 are as follows:

	Acres
Cropland harvested	210,564
Cropland used only for pasture	15,060
Cropland not harvested and not pastured	37,363
Woodland pastured	760
Woodland not pastured	1,393
Other pasture (not cropland and not woodland)	171,495
Other land (house lots, roads, wasteland, etc)	17,216

Farms are classified by size in the 1954 census as follows:

Size of farms (acres)	*Number*
Under 10	57
10 to 29	42
30 to 49	29
50 to 69	23
70 to 99	89
100 to 139	53
140 to 179	153
180 to 219	47
220 to 259	124
260 to 499	365
500 to 999	184
1,000 and over	46

Farms are classified by type in the 1954 census as follows:

	Number
Field-crop farms other than vegetable and fruit-and-nut (cash grain)	682
Dairy farms	46
Poultry farms	25
Livestock farms other than dairy or poultry	178
General farms	130
Primarily crop	11
Primarily livestock	10
Crop and livestock	109
Miscellaneous and unclassified farms	150

FARM TENURE

Less than half of the farmers in the county own all the land they work. About one-third of the farm operators own none of the land they farm. The 1954 census divides the number of farms and acreage in farms as follows:

	Farms reporting	*Acreage*
Full owners	403	77,344
Part owners	414	227,478
Managers	3	97
All tenants	392	148,932
Cash tenants	29	18,859
Share-cash tenants	183	84,030
Share tenants and croppers	153	41,596
Other and unspecified tenants	27	4,447

FARM EQUIPMENT AND EXPENDITURES

Equipment on farms was reported in the 1954 census as follows:

	Farms reporting	*Number of units*
Grain combines	876	987
Cornpickers	36	36
Pickup hay balers	210	211
Field forage harvesters	119	119
Motortrucks	1,030	1,356
Tractors (wheel tractors other than garden)	1,095	1,940
Automobiles	1,094	1,403
Power feed grinder	592	592
Milking machine	186	186

Investment in farm equipment has increased along with the change to tractors. Power machinery is used in preparing and tilling the land and in planting and harvesting crops. Specialized types of less commonly used farm machinery include alfalfa cutters, packers, rod weeders, and hay stackers.

Farm expenditures in 1954 were reported as follows:

	Farms reporting	*Percent of expenditures*
Machine hire	745	8.0
Hired labor	656	22.4
Feed for livestock and poultry	1,053	38.5
Gasoline and other petroleum fuel and oil	1,120	24.2
Commercial fertilizer	486	6.8
Lime and liming materials	12	.1

SOILS OF SALINE COUNTY

In the following pages the soils mapped in Saline County are described and their suitability for crops and grazing are discussed. The management group and range site are indicated for each of the soils mapped. The approximate acreage and proportionate extent of the soils, by soil type, are given in table 5.

TABLE 5.—*Approximate acreage and proportionate extent of soil types*

Soil	Area	Extent
	Acres	*Percent*
Albion loams	50	(1)
Albion coarse sandy loam, shallow	90	(1)
Alluvial land	9,165	2.0
Arkansas fine sandy loams	1,305	.3
Assaria silt loam	665	.1
Assaria silty clay loam	475	.1
Benfield silty clay loams	740	.2
Benfield silty clay loams, shallow	1,635	.4
Berg silt loams	9,725	2.1
Berg silty clay loams	10,220	2.2
Bonaccord silty clay loams	6,390	1.4
Bonaccord silty clay loam-Solonetz complex	1,625	.4
Carlson silty clay loams	225	.1
Cloud silty clay loams	2,630	.6
Detroit silt loams	6,380	1.4
Detroit silty clay loams	14,290	3.1
Detroit silt loams, overwashed	1,210	.3
Detroit loamy very fine sand, overwashed	210	.1
Ebenezer loam	12,120	2.6
Ebenezer silt loams	8,865	1.9
Ebenezer silt loams, colluvial	4,445	1.0
Ebenezer silty clay loams	19,380	4.2
Edalgo silt loams	14,155	3.1
Elmo silt loams	6,325	1.4
Elmo silty clay loams	5,895	1.3
Elmo loams, terrace	275	.1
Elmo silt loams, terrace	410	.1

TABLE 5.—*Approximate acreage and proportionate extent of soil types—Continued*

Soil	Area	Extent
	Acres	*Percent*
Englund silt loams	3,185	0.7
Englund silty clay loam, very shallow variant	40	(1)
Farun fine sandy loams	6,200	1.3
Fore clays	3,380	.7
Fore silty clay loams, deep over silt	3,575	.8
Geary silt loams	4,020	.9
Hall silt loams	8,140	1.8
Hall silt loams, brown subsoil variant	640	.1
Hallville loams	2,540	.6
Hallville loams, shallow	1,480	.3
Hedville loams	14,290	3.1
Hedville stony loams	13,835	3.0
Hobbs silt loams	26,015	5.6
Hobbs silt loam, light-colored variant	220	.1
Humbarger loams	2,900	.6
Humbarger silt loams	12,295	2.7
Idana silt loams	6,570	1.4
Idana silty clay loams	990	.2
Kipp silt loams	1,730	.4
Kipp silty clay loams	2,400	.5
Kipson silt loams	4,440	1.0
Kipson shaly silt loams	2,490	.5
Lancaster loams	36,415	8.0
Lancaster loams, shallow	5,165	1.1
Lancaster fine sandy loams	12,975	2.8
Lancaster fine sandy loams, shallow	2,465	.5
Langley silt loams	5,315	1.2
Langley silty clay loam	445	.1
Langley silt loam-Solonetz complex	1,420	.3
Lanham silt loams	1,545	.3
Lincoln loamy fine sands	140	(1)
Lindsborg silt loam	400	.1
Lockhard silt loams	20,990	4.6
Lockhard loamy fine sand, overblown	190	(1)
Longford silt loams	4,970	1.1
Longford silty clay loams	3,815	.8
Made land	975	.2
Malmgren silt loams	70	(1)
Marydel silt loam	1,360	.3
Marydel loam, poorly drained variant	190	(1)
Marydel fine sandy loam	125	(1)
Marydel loamy fine sand	135	(1)
McPherson silt loam	3,055	.7
Muir silt loams	11,530	2.5
New Cambria silty clay loam	6,475	1.4
Niles silt loams	5,350	1.2
Niles silty clay loams	3,895	.8
Ninnescah silt loams	530	.1
Pratt fine sandy loams	1,140	.2
Rentide silt loam	2,060	.4
Rentide silty clay loam	520	.1
Rentide silt loam, moderately shallow	225	(1)
Rokeby silt loam	1,390	.3
Rough broken and rough stony land, Vernon and Hedville soil materials	2,385	.5
Roxbury silty clay loams	2,155	.5
Salemsburg silt loam	1,880	.4
Shellabarger fine sandy loams	1,000	.2

TABLE 5.—*Approximate acreage and proportionate extent of soil types—Continued*

Soil	Area	Extent
	Acres	*Percent*
Shellabarger loams	1,915	0.4
Shellabarger silt loams	790	.2
Smoky Butte silt loam	680	.1
Smolan silt loams	4,740	1.0
Solomon clay	3,140	.7
Solomon clay, low lime variant	1,710	.4
Stimmel silt loams	850	.2
Stimmel silty clay loam	90	(1)
Sutphen silty clay	8,500	1.8
Tescott silt loam	1,345	.3
Tescott silty clay loam	485	.1
Tobin silt loams	6,725	1.5
Vernon silty clay loams	220	(1)
Wabash silty clay loam	8,430	1.8
Westfall silt loam	5,930	1.3
Westfall silty clay loams	4,300	.9
Windom fine sandy loams	1,710	.4
Windom loams	2,620	.6
Windom loamy fine sands, sandy substratum variant	450	.1
Yordy loams	810	.2
Yordy loams, shallow	695	.1
Yordy silty clay loam	900	.2
Yordy silty clay loam, shallow	795	.2
Total	460,800	100.0

[1] Less than 0.1 percent.

ALBION LOAMS

These deep, sandy, friable soils occupy the high terraces bordering the Smoky Hill River at Salina. The terraces are narrow, have steep slopes facing the river, and consist of stratified sandy and gravelly deposits. The deposits vary in thickness but are always more than 5 feet thick, and they become coarser with increasing depth.

Profile description for Albion loams:

0 to 10 inches, brown (7.5YR 4/2, dry)[3] or dark-brown (7.5YR 3/2, moist) loam; soft when dry, very friable when moist; single grained; neutral.

10 to 24 inches, brown (7.5YR 5/4, dry) or reddish-brown (5YR 4/3, moist) sandy clay loam; hard when dry, friable when moist; moderate coarse prismatic structure that breaks to medium and coarse subangular blocky; neutral in reaction.

24 to 34 inches, brown (7.5YR 5/4, dry) or reddish-brown (5YR 4/4, moist) sandy loam; slightly hard when dry, very friable when moist; massive to weak coarse subangular blocky structure; neutral to mildly alkaline.

34 to 44 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/4, moist) sandy loam; slightly hard when dry, very friable when moist; massive; calcareous; contains nodules and mycelia of calcium carbonate.

44 to 48 inches, light yellowish-brown (10YR 6/4, dry) or yellowish-brown (10YR 5/4, moist) calcareous, sand or loamy sand, massive; contains some granitic gravel and nodules of calcium carbonate.

[3] Munsell color notation.

These soils are well drained to somewhat excessively drained and well oxidized. In most areas occupied by these soils, surface runoff is very slow. Nevertheless, the moderately rapid to rapid permeability of the soils and of the sandy and gravelly substrata permits free movement of water. Because of their rapid internal drainage, these soils are low in water-holding capacity and tend to be droughty. Their friable surface and subsurface layers are susceptible to wind erosion if the soil structure is destroyed.

Albion loam, 2 to 6 percent slopes (Ab; group 22A).—The physical characteristics and profile for this mapping unit are the same as those described for the soil type. Range site: loamy upland.

Albion loam, 6 to 12 percent slopes (Ac; group 22B).—This mapping unit has a slightly thinner surface layer than that described as normal for the soil type. The subsoil layers also are thinner and have a more massive structure. The surface soil usually ranges from 4 to 6 inches in thickness, and the combined surface soil and subsoil layers range from 35 to 40 inches. Range site: loamy upland.

ALBION COARSE SANDY LOAM, SHALLOW

This soil type has a friable, loose surface layer and very coarse-textured gravelly subsoil and substratum. It is moderately deep to shallow and occurs near the margins of the high terraces along the Smoky Hill River, mainly within the city limits of Salina. The parent materials exceed 5 feet in thickness.

Profile description of Albion coarse sandy loam:

0 to 13 inches, brown (7.5YR 4/2, dry) or very dark gray (7.5YR 3/1, moist) coarse sandy loam; loose when dry, nonplastic when wet; single grained; slightly acid; contains much rounded granitic gravel.

13 to 40 inches, yellowish-red (5YR 4/6, dry) or dark reddish-brown (5YR 3.5/3, moist) gravelly loamy sand; loose when dry, nonplastic when wet; slightly acid.

This soil is excessively drained and well oxidized. There is very little surface runoff, but the internal permeability of the soil is very rapid and the underdrainage is open and free. The water-storing capacity is very small, so the soil is too droughty for the growth of most tilled crops.

Albion coarse sandy loam, shallow phase, 2 to 6 percent slopes (Aa; group 1A).—The profile of this mapping unit is the same as that described for Albion coarse sandy loam. Range site: sandy land.

ALLUVIAL LAND

Alluvial land (Ad; group 24).—This miscellaneous land type occupies the steeply sloping banks and channels of the major streams. These areas cannot be used as cropland and have very limited value as grazing land. They are generally covered by tall trees and brush and thus provide some of the wood needed on the farm. Since these areas cannot be crossed by farm implements or grazing animals, they form natural barriers that are sometimes accepted as ownership boundaries. Range site: lowland.

ARKANSAS FINE SANDY LOAMS

These nearly level to gently sloping soils occupy flats and natural levees along both present and abandoned stream channels. These soils are mainly along Gypsum Creek in the vicinity of Gypsum. They are developing in medium to moderately coarse textured, highly stratified, calcareous alluvial materials of recent age. The alluvial deposits generally have a thickness of more than 5 feet. In some localities, these soils overlie weakly developed soils that have formed from similar parent materials.

Profile description of Arkansas fine sandy loam:

0 to 8 inches, gray (10YR 5/1.5, dry) or dark-gray (10YR 4/1.5, moist) fine sandy loam; soft when dry, very friable when moist; weak fine granular structure, neutral in reaction.

8 to 20 inches, grayish-brown (10YR 5/2, dry) or very dark gray (10YR 3/1, moist) fine sandy loam; slightly hard when dry, very friable when moist; weak coarse subangular blocky structure breaking to medium-sized granules; neutral in reaction.

20 to 30 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) loam to fine sandy loam; slightly hard when dry, friable when moist; weak coarse subangular blocky structure; neutral to mildly alkaline in reaction.

30 to 42 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; mildly alkaline to calcareous; may contain variable amounts of accumulated calcium carbonate.

These soils are well drained and well oxidized throughout their profile. Surface runoff usually is slow, but the soils have moderate to rapid permeability, and their internal drainage is free. High water tables seldom occur. The soils have a moderate to low moisture-holding capacity and are droughty during periods of low rainfall. They are easily tilled within a wide range of moisture content, but unless they are properly managed, the weak structure of the surface soil is easily destroyed. In some localities these soils are calcareous below depths of 30 inches, and in other areas they are noncalcareous to depths of at least 5 feet.

Arkansas fine sandy loam, 0 to 2 percent slopes (Ae; group 21A).—The soil profile for this mapping unit is the same as that described as normal for Arkansas fine sandy loams. Range site: lowland.

Arkansas fine sandy loam, 2 to 6 percent slopes (Af; group 21B).—This soil occupies the less uniform and steeper slopes of terraces. It occurs in narrow, elongated, irregularly shaped areas that are often difficult to till. The surface soil is generally thinner than that described for Arkansas fine sandy loams. Range site: lowland.

ASSARIA SILT LOAM

This deep, friable, silt loam soil of the upland occurs in covelike areas at the heads of small drainageways, principally in the eastern part of the county. It occupies the foot slopes of coves. It has developed on highly calcareous, fine-textured materials weathered from shale and limestone. Partially weathered bedrock is present at depths of 4 to 6 feet. Although not easily distinguished, the upper foot of this soil probably contains wind-deposited materials (loess).

Profile description of Assaria silt loam:

0 to 6 inches, gray (10YR 5/1, dry) to very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

6 to 13 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; neutral to slightly acid.

13 to 28 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, very firm when moist, very plastic when wet; strong medium blocky structure; neutral in reaction.

28 to 32 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate medium to coarse blocky structure; calcareous; contains nodules and mycelia of calcium carbonate.

32 to 40 inches, light yellowish-brown (10YR 6/4, dry) or brown (10YR 5/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to weak coarse subangular blocky structure; calcareous; contains accumulated calcium carbonate and fragments of partially weathered shale.

40 inches +, partially weathered, calcareous clay shale.

This soil is well drained to moderately well drained. Because of the gentle gradient and characteristically concave landform, water moves across the surface slowly, and much runoff is received from adjacent areas. Water penetrates the surface layers fairly rapidly but moves slowly in the fine-textured part of the profile below approximately 18 inches. Internal drainage is further restricted by the underlying beds of shale, which cause ground waters to move laterally along their surface. Soil moisture is favorable to plants, but much of the stored water is not available, because of the heavy-textured and compact subsoil. Plants tend to develop shallow root systems when this soil is waterlogged, and they are damaged by the long periods of drought that follow.

This soil is best suited to shallow-rooted grain crops and crops that do not require large amounts of moisture late in the growing season. Deep-rooted crops are suggested for the crop rotation to improve the permeability of the subsoil.

Assaria silt loam, 2 to 6 percent slopes (Ag; group 6A).—The profile of this mapping unit is the same as that described for Assaria silt loam. Range site: clay upland.

ASSARIA SILTY CLAY LOAM

This deep, silty clay loam soil occurs in covelike areas with Assaria silt loam, 2 to 6 percent slopes. It usually occupies positions where erosion has removed the silt loam surface soil. Consequently, the influence of loess material in the surface layer is less noticeable. The subsurface layers are similar to those of the Assaria silt loam. Unweathered or partially weathered calcareous shales and interbedded limestones are present at depths of 40 to 50 inches.

Profile description of eroded Assaria silty clay loam:

0 to 7 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay loam; hard when dry, friable when moist; weak fine and very fine subangular blocky structure; neutral to slightly acid.

7 to 22 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; strong medium blocky structure; neutral in reaction.
22 to 30 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate coarse blocky structure; calcareous; contains some accumulated lime.
30 to 38 inches, light yellowish-brown (10YR 6/4, dry) or brown (10YR 5/3, moist) clay; extremely hard when dry, extremely plastic when wet; massive to weak coarse subangular blocky structure; calcareous; contains some accumulated lime and fragments of partially weathered shale.
38 inches +, calcareous, clay shales.

This is a moderately well drained soil. Water enters the heavier textured surface layer less readily than it enters Assaria silt loam. The underlying beds of shale cause ground water to move laterally through the soil and thus restrict the internal drainage.

Restricted drainage and loss of friable surface soil limit free growth of roots in this soil to the shallow surface layer. Consequently, crops are more susceptible to damage by drought and by deficiencies in plant nutrients. Soil tests show this soil to be deficient in phosphorus and nitrogen. Tillage is possible only within a narrow range of soil moisture content. If tilled too wet, the soil puddles easily. It is difficult, therefore, to prepare a smooth seedbed. Tillage is even more difficult where the fine-textured subsoil extends into the plow layer.

Assaria silty clay loam, 2 to 6 percent slopes, eroded (Ah; group 6B).—The profile of this mapping unit is the same as that described for eroded Assaria silty clay loam. Range site: clay upland.

BENFIELD SILTY CLAY LOAMS

These deep, friable, silty clay loam soils occupy the slopes of low hills and ridges, mainly in the eastern part of the county. They all occur on 2 to 6 percent slopes, but they differ in degree of erosion. The hills are capped by remnants of Cretaceous sandstone and shale, which are underlain by Permian shales and interbedded limestones. The fine-textured, calcareous parent materials are a mixture of colluvium from the higher lying Cretaceous beds, Loveland loess, and weathered shale and limestone materials from the underlying Permian beds.

Profile description for deep, uneroded, Benfield silty clay loams:

0 to 6 inches, brown (7.5YR 5/4, dry) to dark-brown (7.5YR 3/2, moist) silty clay loam; hard when dry, very friable when moist; moderate fine granular structure; slightly acid.
6 to 16 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate very coarse granular and very fine subangular blocky structure; slightly acid to neutral in reaction.
16 to 22 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/3, moist) light silty clay; hard when dry, friable when moist; moderate medium subangular blocky structure; nearly neutral in reaction.
22 to 28 inches, brown (7.5YR 5.5/4, dry) or (7.5YR 5/4, moist) light silty clay; extremely hard when dry, very plastic when wet; weak coarse and medium blocky structure; nearly neutral in reaction.

28 to 35 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; neutral to mildly alkaline; contains fragments of partially weathered shale and limestone.

35 to 45 inches, yellowish-brown (10YR 5/4, dry) or brown (10YR 4/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; calcareous; contains fragments of partially decomposed shale and nodules of calcium carbonate.

45 inches +, pale yellow (2.5Y 7/4, moist) calcareous clay shales.

Benfield silty clay loams are well drained. In most areas surface runoff is medium to rapid. Fixed water tables seldom occur, but lateral movement of ground water above the shale beds restricts internal drainage. Moisture stored in the fine-textured subsoils is not readily available for plants and in some instances interferes with free development of roots. For this reason early maturing crops and crops with roots that can penetrate the heavier subsoils are best suited.

Benfield silty clay loam, 2 to 6 percent slopes (Bh; group 9B).—This soil generally occurs on convex foot slopes. The profile characteristics are the same as those described as normal for deep, uneroded Benfield silty clay loams. Range site: clay upland.

Benfield silty clay loam, 2 to 6 percent slopes, eroded (Bb and Bk; group 9B).—The profile for this soil is similar to that described for uneroded Benfield silty clay loams, but one-quarter to three-quarters of the surface soil has been removed by erosion. The plow layer includes part of the upper subsoil. Range site: clay upland.

Benfield silty clay loam, 2 to 6 percent slopes, severely eroded (Bc and Bl; group 9C).—The soil profile for this mapping unit is similar to that described for uneroded Benfield silty clay loams, but all of the surface soil and part of the upper subsoil have been removed by erosion. Range site: clay upland.

BENFIELD SILTY CLAY LOAMS, SHALLOW

The shallow Benfield silty clay loams have developed on the crests and shoulders of low hills and ridges in the eastern and central parts of the county. Their parent materials are similar to those of the deeper Benfield silty clay loams already discussed, but depth to bedrock is only 24 to 30 inches.

Profile description for uneroded shallow Benfield silty clay loams:

0 to 6 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2/2, moist) silty clay loam; soft when dry, very friable when moist; moderate fine granular structure; slightly acid.

6 to 14 inches, dark reddish-gray (5YR 4/2, dry) to dark reddish-brown (5YR 3/2, moist) silty clay loam; plastic when wet, friable when moist, and hard when dry; moderate fine and very fine subangular blocky structure; nearly neutral in reaction.

14 to 22 inches, dark reddish-brown (5YR 3/4, dry) or (5YR 3/3, moist) silty clay; extremely plastic when wet, extremely hard when dry; weak coarse subangular blocky structure; nearly neutral in reaction.

22 to 28 inches, pale-olive (5Y 6/3, dry) or olive (5Y 5/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; slightly calcareous in reaction; mottled with stains of dark brown (7.5YR 3/2, dry); contains fragments of partially weathered shale and a few small nodules and concretions of calcium carbonate.

28 inches +, pale-yellow (5Y 7/3, dry) or pale-olive (5Y 5/3, moist) calcareous clay shales and interbedded thin limestones.

These shallow soils have drainage, structural, and textural characteristics that are similar to those of the deeper Benfield silty clay loams. They differ from them in depth to the heavier subsoil and bedrock. Where it is exposed by erosion, the subsoil turns up in hard resistant clods during tillage. The shallow depth to the underlying shale beds also restricts free root growth to the upper 18 to 30 inches. These soils are nearly always deficient in phosphorus.

Benfield silty clay loam, shallow phase, 2 to 6 percent slopes (Bd; group 5A).—This mapping unit has the same profile characteristics as those described for uneroded shallow Benfield silty clay loams. Range site: clay upland.

Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, eroded (Be; group 5A).—The profile of this soil is similar to that described for uneroded shallow Benfield silty clay loams, but it has lost one-quarter to three-quarters of its surface horizon through erosion. Part of the subsoil is included in the plow layer. Range site: clay upland.

Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, severely eroded (Bf; group 5B).—This soil has lost nearly all of the surface horizon and most, or all, of the upper subsoil. The plow layer includes finer textured and less friable lower subsoil horizons. Fertility and depth of soil have been greatly reduced, and some gullying is usually present. Range site: clay upland.

Benfield silty clay loam, shallow phase, 6 to 12 percent slopes, severely eroded (Bg; group 5B).—This soil occurs on steeply sloping hill crests and ridges that are severely eroded. All of the surface horizon and the upper subsoil have been lost through erosion. In many places most of the lower subsoil has also been removed. Most areas are badly gullied, and, in some, shale rock is exposed. The soil is unproductive and should be seeded to grass and managed in a way that will protect soils at lower levels from erosion. Range site: clay upland.

BERG SILT LOAMS

These deep, friable upland soils are most extensive in the south-central and eastern parts of the county. They have developed in friable, calcareous, uniformly silty, wind-deposited materials of Wisconsin age. These materials average about 5 feet in thickness and overlie brown or reddish-brown, silty, wind-deposited materials of older age (Loveland loess). Occasionally they overlie bedrock or products of bedrock weathering. They generally occupy the crests, shoulders, and upper foot slopes of low hills and ridges.

Profile description for Berg silt loams:

0 to 8 inches, grayish-brown (10YR 5/2, dry) to dark grayish-brown (10YR 3.5/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate to strongly developed fine crumb structure; slightly acid.

8 to 16 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/2, moist) silty clay loam; hard when dry, friable when moist; moderately developed very fine subangular blocky structure; slightly to moderately acid.

16 to 22 inches, brown (10YR 5/3, dry) or dark-brown (10YR 4/3, moist) heavy silty clay loam; very hard when dry, firm when moist; moderately developed fine blocky structure; approximately neutral in reaction.

22 to 30 inches, brown (10YR 5/3, dry) or dark-brown (10YR 4/3, moist) light silty clay; very hard when dry, firm when moist; moderately developed fine and medium blocky structure; approximately neutral in reaction.

30 to 50 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, and friable when moist; massive; calcareous; contains a few concretions of calcium carbonate.

These soils are well drained. Surface runoff is medium, and the movement of water downward through the heavier subsoil is moderately rapid.

Berg silt loam, 0 to 2 percent slopes (Bm; group 9A).—This soil generally occurs on gentle foot slopes. It differs slightly from the typical profile for Berg silt loams in having a slightly thicker and darker colored surface layer and a slightly darker colored and heavier textured subsoil. Range site: clay upland.

Berg silt loam, 2 to 6 percent slopes (Bn; group 9B).—This soil occurs on gently sloping foot slopes and undulating low hills. Its profile characteristics are similar to those described as normal for Berg silt loams. Range site: clay upland.

BERG SILTY CLAY LOAMS

Berg silty clay loams occur in upland positions with Berg silt loams. They generally occupy the steeper slopes or other positions where erosion has occurred. As a result they have lost their silt loam surface layer. In other characteristics, and in their parent materials, they are very similar to Berg silt loams.

Profile description for eroded Berg silty clay loams:

0 to 6 inches, brown (10YR 5/3, dry) or (5YR 3/3, moist) silty clay loam; hard when dry, friable when moist; moderate fine and very fine subangular blocky structure; slightly to moderately acid.

6 to 14 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) heavy silty clay loam; very hard when dry, firm when moist; moderate fine blocky structure; nearly neutral in reaction.

14 to 24 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) light silty clay; very hard when dry, firm when moist; moderately developed medium blocky structure; nearly neutral in reaction.

24 to 44 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; calcareous; massive; hard when dry, friable when moist; contains a few nodules of calcium carbonate.

44 to 60 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silt loam; hard when dry, friable when moist; massive; calcareous; contains a few nodules of calcium carbonate but less than the horizon above.

Because these soils have a fine-textured surface layer, they have greater runoff than Berg silt loams, absorb less water, are more difficult to keep in good tilth, and are more susceptible to erosion.

Berg silty clay loam, 2 to 6 percent slopes, eroded (Bo; **group** 9B).—This soil has a profile similar to that described as normal for the Berg silty clay loam. It occurs on the ridge tops and side slopes where erosion has removed most of the surface soil. Range site: clay upland.

Berg silty clay loam, 2 to 6 percent slopes, severely eroded (Bp; group 9C).—The soil profile of this unit differs from that described as normal for Berg silty clay loam in having lost 6 inches or more of its surface layer by erosion. This erosion has resulted in a serious loss of natural soil fertility. Range site: clay upland.

BONACCORD SILTY CLAY LOAMS

These deep, friable, fine-textured soils occur on nearly level to gently sloping high terraces along Mulberry, Spring, and Dry Creeks. The terraces are broad, and the soils sometimes occupy concave or slightly depressed areas on them. The parent materials are calcareous, moderately fine textured silty deposits of mixed alluvium and windblown silts. These deposits are older than those left by present streams; their age is believed to be comparable to that of the deposits of Loveland loess.

Profile description for uneroded Bonaccord silty clay loams:

0 to 6 inches, gray (10YR 5/1, dry) or dark-gray (10YR 3.5/1, moist) silty clay loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; neutral in reaction.

6 to 16 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; slightly hard when dry, friable when moist; moderate very fine subangular blocky structure; nearly neutral in reaction.

16 to 24 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate to strong medium blocky structure; nearly neutral in reaction.

24 to 36 inches, brown (10YR 5/3, dry) or grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, very plastic when wet; moderately developed medium blocky structure; slightly alkaline in reaction.

36 to 48 inches, light brownish-yellow (10YR 6/4, dry) or brown (10YR 5/3, moist) silty clay loam; very hard when dry, firm when moist; massive; calcareous; contains prominent yellowish-red (7.5YR 5/6) or yellow (10YR 7/6) mottles and a few small concretions of calcium carbonate.

Bonaccord silty clay loams are moderately well drained. Surface runoff is slow in most areas, and water usually stands on the surface for short periods after rains. Permeability is moderately slow to slow because of the fine-textured, compact subsoils. Underdrainage is moderately free, and water tables sometimes develop. The water-storing capacity of these fine-textured soils is large, but soil moisture is only slowly made available to plants.

These soils are moderately productive, but their compact subsoils restrict root development. They are often deficient in phosphorus and nitrogen. Supplemental fertilizers are needed to enable plant roots to penetrate the compact subsoils. They have fair qualities of tilth, but tillage is limited to a narrow range of soil moisture content. When exposed, the lower subsoils are hard to work and turn up in hard resistant clods if plowed when dry. The subsoil puddles easily when tilled too wet and forms a hard, almost impermeable crust upon drying.

Bonaccord silty clay loam, 0 to 2 percent slopes (Br; group 8A).—The profile characteristics for this mapping unit are similar to those described as normal for uneroded Bonaccord silty clay loams. Range site: lowland.

Bonaccord silty clay loam, 2 to 6 percent slopes (Bs; group 8B).—This soil has somewhat thinner surface soil than that described as normal for Bonaccord silty clay loams. It occurs on slopes along drainage channels, often in long, narrow, irregularly shaped areas that are difficult to manage as separate units. These areas are best used as permanent pasture and maintained as waterways and drainageways. Range site: lowland.

Bonaccord silty clay loam, 2 to 6 percent slopes, eroded (Bt; group 8B).—The profile of this mapping unit differs from that described as normal for Bonaccord silty clay loams in having lost 2 to 4 inches of surface soil through erosion. Some of the fine-textured upper subsoil is included in the plow layer. For this reason, the soil is more difficult to till and manage properly than the uneroded phases. Since it occurs in similar positions and has characteristics that are similar to those of Bonaccord silty clay loam, 2 to 6 percent slopes, its use and management are much the same. Range site: lowland.

BONACCORD SILTY CLAY LOAM-SOLONETZ COMPLEX

This complex of intricately associated soils occurs on nearly level terraces along Spring, Mulberry, and Dry Creeks in the western part of the county. The complex is easily located in the field by numerous salt spots or barren areas (pl. 1). The salt spots occupy about one-third of the total area of the complex and limit its use and management. The salt spots occur as small patches about 15 or 20 feet in diameter. They are separated from each other by areas of normal Bonaccord silty clay loam soil, but in some areas they are so numerous that fields consist almost entirely of Solonetz soil.

Profile description for Solonetz areas in the complex:

0 to 3 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; soft when dry, very friable when moist; moderate fine platy structure; nearly neutral in reaction.

3 to 15 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) clay; extremely hard when dry, extremely plastic when wet; strong medium blocky structure; strongly alkaline in reaction.

15 to 30 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately developed medium to coarse blocky structure; strongly alkaline in reaction; contains moderate amounts of accumulated salt as nodules and in powdered form.

30 to 42 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weak coarse subangular blocky structure; strongly alkaline in reaction; contains moderate amounts of accumulated salt and is mottled with strong-brown streaks and stains.

42 to 60 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) light silty clay or heavy silty clay loam; very hard when dry, very plastic when wet; massive; strongly alkaline in reaction; contains some accumulated salt and is mottled with strong-brown streaks and stains.

Solonetz areas develop where sodium salts accumulate in the soil profile. Such accumulations usually result from salt concentrations in the parent material, or from salt residues left in the soil through evaporation of saline ground waters or floodwaters.

Where sufficiently concentrated, the salts are toxic to plants and cause the colloidal, or clay, particles in the soil to disperse. The dispersed particles collect a few inches below the surface to form a hard claypan. The claypan thus formed restricts both the movement of water in the soil and in the growth of plant roots.

Most Solonetz areas have nearly level or slightly concave surfaces. Their loose surface soils are very susceptible to erosion. Therefore, the centers of Solonetz areas are often 3 or 4 inches lower than the rims. Rain or runoff water usually gathers in the depressions and, because of the underlying claypan, remains there until evaporated. During the rainy season, high water tables are often present in this soil complex.

Bonaccord silty clay loam-Solonetz complex, 0 to 2 percent slopes (Bu; group 23).—The profile of the Solonetz soil in this complex is described in the preceding paragraphs. The profile of an uneroded Bonaccord silty clay loam soil is described on page 21. Range site: lowland.

CARLSON SILTY CLAY LOAMS

These moderately deep, friable silt loams occupy the crests or shoulders of hills and ridges in the western part of the county. They have developed in friable Tertiary outwash materials that normally range from about 5 to 6 feet in thickness. The parent materials are strongly impregnated with finely divided chalklike lime deposits that look much like marl.

Profile description for Carlson silty clay loams:

0 to 10 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine granular structure; nearly neutral in reaction.

10 to 36 inches, brown (7.5YR 5.5/4, dry) or (7.5YR 5/4, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

36 to 60 inches, light-brown (7.5YR 6/4, dry) or brown (7.5YR 5/4, moist) silty clay loam; hard when dry, friable when moist; massive; very calcareous; contains large amounts of accumulated calcium carbonate; where the lime content is very high the entire layer may appear nearly white.

These are well-drained soils. In most areas surface runoff is medium to rapid. Part of the water falling on the soil during normal rainfall is lost as runoff, but a fair amount enters the soils. Permeability is moderately rapid, and underdrainage is free. The water-storing capacity is fairly large, and most of the stored moisture is available to growing plants.

Carlson silty clay loam, 2 to 6 percent slopes (Ca; group 9B).—This mapping unit has the same profile characteristics as those described for Carlson silty clay loams. None of this soil is tilled. Range site: clay upland.

Carlson silty clay loam, 6 to 12 percent slopes (Cb; group 9D).—This soil occurs on the steeply sloping shoulders of ridges. The soil profile rarely exceeds 24 inches in thickness, and in places the limy beds lie within a few inches of the surface. The profile differs somewhat from that described as normal for Carlson silty clay loams. The surface soil, 5 to 7 inches thick, is gray to dark-gray,

calcareous, granular, silty clay loam. It is underlain to depths of 16 or 18 inches by light-brown to brown, calcareous, granular to fine subangular blocky, silty clay loam. Below this layer the soil grades to a light-brown or brown, massive, calcareous, very limy silty clay loam. Range site: clay upland.

CLOUD SILTY CLAY LOAMS

These are shallow, moderately fine textured Lithosols. They have developed from fine-textured, noncalcareous Cretaceous clay shales of the Dakota formation. They occupy the crests and shoulders of hills and ridges wherever these materials lie close to the surface. They occur mostly in the western part of the county.

Profile description for uneroded Cloud silty clay loams:

0 to 8 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) silty clay loam; slightly hard when dry, very friable when moist; moderate coarse granular structure; nearly neutral in reaction.

8 to 60 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) soft, partially weathered clay shale beds.

These are well-drained soils. In most areas runoff is very rapid and may cause erosion on surrounding soil areas. Permeability is very slow, and underdrainage is restricted in most places. Ground water moves laterally above the Cretaceous shale beds and occurs as seeps or springs at lower elevations. The water-storing capacity of these soils is low.

These soils are unproductive and very susceptible to erosion when tilled. They are best used as grazing land.

Cloud silty clay loam, 2 to 6 percent slopes (Cc; group 1A).—This soil has profile characteristics similar to those described as normal for Cloud silty clay loams. Range site: shallow land.

Cloud silty clay loam, 6 to 12 percent slopes (Cd; group 1A).—This soil differs from normal Cloud silty clay loams in having slightly lighter colors and a thinner profile. Range site: shallow land.

Cloud silty clay loam, 6 to 12 percent slopes, severely eroded (Ce; group 1B).—This soil is seriously eroded. In many areas the surface horizon has been partially or entirely removed. Where this degree of erosion has occurred, unweathered Cretaceous shale makes up the greater part of the plow layer and is sometimes exposed. The amount of runoff on this soil is much greater than for the Cloud silty clay, 6 to 12 percent slopes. Range site: shallow land.

DETROIT SILT LOAMS

Detroit silt loams are deep, friable, moderately fine textured soils on terraces. They occur throughout the county, but their greatest extent is in the valley along the Saline, Solomon, and Smoky Hill Rivers and along Gypsum Creek. They usually are on broad, low terraces that are midway between present stream channels and bordering uplands. They have developed in moderately fine textured alluvial materials that are usually greater than 5 feet in thickness but are not highly stratified. In some areas these soils overlie brighter colored materials that have a higher content of fine and very fine sand and are much more highly stratified.

Profile description for Detroit silt loams:

0 to 6 inches, gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard to soft when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.

6 to 16 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular to very fine subangular blocky structure; nearly neutral in reaction.

16 to 34 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; weak to moderate, fine and medium subangular blocky structure; hard when dry, friable when moist; nearly neutral to slightly alkaline in reaction.

34 to 40 inches, light yellowish-brown (10YR 6/4, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive to very weak coarse subangular blocky structure; calcareous; contains nodules and mycelia of calcium carbonate.

These are well-drained soils. In most areas surface runoff is medium to slow. After heavy rainfall, water may stand for short periods. However, permeability is moderately rapid, and underdrainage is free. These soils have a large water-storing capacity, and much of the water stored is available to growing plants.

These are among the most productive soils in the county. They are resistant to erosion and are easily tilled within a wide range of soil moisture content if they are properly managed. Included with these soils are a few areas that are slightly lighter colored but otherwise similar.

Detroit silt loam, 0 to 2 percent slopes (Db; group 18A).—This mapping unit has profile characteristics similar to those described for Detroit silt loams. Range site: lowland.

Detroit silt loam, 2 to 6 percent slopes (Dc; group 18B).—These areas generally have a thinner surface soil than that described as normal for the soil type. They occur as long soil bodies on banks and in channels of shallow drainage courses and oxbow remnants. Because of their shape and position, they are difficult to manage as individual units. Range site: lowland.

DETROIT SILTY CLAY LOAMS

Detroit silty clay loams are deep soils characterized by friable, moderately fine textured surface layers and upper subsoils and lower subsoils that consist of fine-textured less permeable materials. Although they occur throughout the county, these soils generally occupy the nearly level to slightly concave upland margins of terraces along the Saline, Solomon, and Smoky Hill Rivers. They have developed in friable, fine to moderately fine textured, calcareous alluvium. In most places the parent materials are thicker than 5 feet. They do not show much stratification but tend to be uniformly silty throughout.

Profile description for uneroded Detroit silty clay loams:

0 to 10 inches, gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, very friable when moist; moderate fine granular structure; nearly neutral in reaction.

10 to 26 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

26 to 32 inches, grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 3/2, moist) light silty clay or heavy silty clay loam; very hard when dry, very plastic when wet; moderate to weak coarse and medium subangular blocky structure; slightly alkaline in reaction.

32 to 40 inches, grayish-brown (10YR 4/2, dry) to dark grayish-brown (10YR 3/2, moist) light silty clay or heavy silty clay loam; very hard when dry, very plastic when wet; calcareous; contains a few concretions of calcium carbonate.

These are moderately well drained soils. In most areas runoff is slow to very slow, and ponding may occur after heavy rains. The surface layer and upper subsoil have moderately slow permeability, but the lower subsoil is only slowly permeable. Underdrainage is slow and water tables sometimes develop. These soils have a large water-storing capacity, but much of the moisture stored in the fine-textured lower subsoil is not readily available to plants.

Detroit silty clay loams are moderately productive and suited to most crops grown in the county. Field trials do not show any serious deficiency of plant nutrients, but supplemental nitrogen promotes the growth of crops when the spring season is cold and wet. Both the surface soil and upper subsoil have a moderately resistant structure that makes tillage fairly easy. The use of conventional machinery, however, is limited to a narrow range of soil moisture content. When exposed, the lower subsoil is hard to work and turns up as hard resistant clods that are difficult to work down to a good seedbed. The soils puddle easily if tilled when wet and are extremely hard to work when dry. Some lighter colored soil areas are included that are otherwise similar to Detroit silty clay loams.

Detroit silty clay loam, 0 to 2 percent slopes (Df; group 14A).—The profile characteristics for this mapping unit are the same as those described for uneroded Detroit silty clay loams. Range site: lowland.

Detroit silty clay loam, 2 to 6 percent slopes (Dg; group 14B).—This soil has a somewhat shallower profile and thinner surface horizons than is normal for uneroded Detroit silty clay loams. Since it usually occurs as long narrow areas, it is difficult to manage as a separate unit. Range site: lowland.

Detroit silty clay loam, 2 to 6 percent slopes, eroded (Dh; group 14B).—This soil differs from the typical uneroded Detroit silty clay loams in having lost 3 inches or more of the surface soil because of erosion. Erosion has intensified the need for good management practices but has not seriously altered the character of the soil. Management practices therefore are the same as those suggested for Detroit silty clay loam, 2 to 6 percent slopes. Range site: lowland.

DETROIT SILT LOAMS, OVERWASHED

These soils occupy the natural levees and low terraces along stream channels. Their greatest acreage is near the junction of the valleys of Spring Creek and the Smoky Hill River. They are characterized by silty deposits that overlie soils very similar to Detroit silt loams. The deposits range from 14 to 30 inches in thickness, but they usually are about 20 to 24 inches thick. They were derived from Cretaceous materials that are low in calcium and from highly weathered soils that have been strongly leached. Consequently, they are moderately acid.

Profile description of Detroit silt loams, overwashed:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3.5/2, moist) silt loam; slightly hard to soft when dry, very friable when moist; weak fine crumb structure; moderately acid.
6 to 23 inches, brown (10YR 5/3, dry) to dark grayish-brown (10YR 4/2, moist) silt loam; hard when dry, very friable when moist; massive to weak coarse granular structure; moderately acid.
23 to 40 inches, dark grayish-brown (10YR 4.5/1.5, dry) or very dark grayish-brown (10YR 3.5/1.5, moist) silty clay loam; hard when dry, friable when moist; weak to moderate coarse granular structure; nearly neutral in reaction.
40 to 50 inches, pale-brown (10YR 6/3, dry) to brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; usually contains a few small nodules of calcium carbonate.

The soils of this overwashed unit are well drained. In most areas surface runoff is medium to rapid, soil permeability is moderate, and underdrainage is free. The water-storing capacity is fairly large, and most of the water is available to plants.

These overwash soils are moderately productive. Most crops grown in the county can be grown on them, but they are best suited to crops that are tolerant of acid soil. Small grains, sorghum, and corn are best. Liming of fields prior to seeding alfalfa and sweetclover is beneficial. The soils are friable, possess good tilth, and can be tilled throughout a wide range of moisture content. They are susceptible to wind erosion if improperly managed.

Detroit silt loam, overwash phase, 0 to 2 percent slopes (Dd; group 19A).—The profile characteristics of this mapping unit are the same as those described as normal for Detroit silt loams, overwashed. Range site: lowland.

Detroit silt loam, overwash phase, 2 to 6 percent slopes (De; group 19B).—This mapping unit has lighter colored and thinner surface horizons than those described as normal for Detroit silt loams, overwashed. Deposits of overwash are generally thinner than those of Detroit silt loam, overwash phase, 0 to 2 percent slopes. Management is more of a problem on this soil because of the stronger slope and the long, narrow, irregular shape of its areas. Range site: lowland.

DETROIT LOAMY VERY FINE SAND, OVERWASHED

This mapping unit consists of light-colored sandy deposits that overlie a buried soil. The profile characteristics of the buried soil are very similar to those described for Detroit silt loams. The small acreage of this overwash soil is largely confined to flat areas near the mouths of streams. The thickness of the deposits varies from 18 to 30 inches or more, but the average thickness is between 22 and 24 inches.

Profile description of Detroit loamy very fine sand, overwash phase:

0 to 13 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/2, moist) loamy very fine sand; soft when dry, very friable when moist; weak very fine granular to single-grained structure; moderately acid.

13 to 16 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) loam or silt loam; slightly hard when dry, very friable when moist; weak fine granular structure; slightly to moderately acid.
16 to 30 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; nearly neutral in reaction.
30 to 36 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly hard to hard when dry, friable when moist; moderate to weak fine granular structure; nearly neutral in reaction.
36 to 54 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; weak medium subangular blocky structure; neutral to slightly alkaline in reaction.

This is a well drained to somewhat excessively drained soil. Surface runoff is very slow, but permeability is rapid in the coarse-textured overwash and moderate in the buried soil. Underdrainage is free, and water tables normally do not develop. The water-storing capacity of the overwash material is very low, but that of the buried soil is high. The surface layers therefore tend to be droughty, and shallow-rooted crops are often damaged. The supply of water in the buried soil is ample for deep-rooted crops.

This soil is moderately productive, and most crops common to the county can be grown on it. It is best suited, however, to drought-resistant or deep-rooted crops. Its acid reaction is sufficient to retard growth of some crops. It also is deficient in nitrogen where wheat and sorghum have been grown without legumes in the crop rotation. The soil possesses good qualities of tilth, but its loose and powderlike properties when tilled make it very susceptible to wind erosion.

Detroit loamy very fine sand, overwash phase, 0 to 2 percent slopes (Da; group 22A).—The profile characteristics of this mapping unit are the same as those described as normal for Detroit loamy very fine sand, overwash phase. Range site: lowland.

EBENEZER LOAM

This is a deep soil with a friable crumb-structured surface layer. It occupies the slopes of hills and ridges, principally in the western part of the county. It has developed in friable, calcareous, uniform, silty wind-deposited materials, but the surface layer has been modified by material weathered from nearby exposures of sandstone and sandy shales. Consequently, the surface layer has a loam texture rather than a silt loam. The parent materials average about 5 feet in thickness and usually overlie strata of shale and sandstone bedrock.

Profile description of Ebenezer loam:

0 to 5 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3/2, moist) loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.
5 to 12 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 3.5/2, moist) light silty clay loam; slightly hard to hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; slightly acid; surfaces of aggregates may have a thin light-gray coating during dry periods.

12 to 23 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate to strong medium blocky structure; nearly neutral in reaction.

23 to 32 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak to moderately developed medium and coarse subangular and angular blocky structure; neutral to slightly alkaline in reaction.

32 to 42 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weak coarse subangular blocky structure; calcareous; contains nodules and concretions of calcium carbonate.

42 to 60 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; very hard when dry, and very plastic when wet; massive; calcareous; horizon is mottled with reddish-brown streaks and stains.

Ebenezer loam is a well-drained soil. In most areas, surface runoff is moderate. During normal rainfall, part of the water falling on this soil is lost, but the moderately permeable subsoil permits fair penetration. The rate of surface runoff increases where the physical structure of the surface layer is not maintained by proper management. Underdrainage is only moderate. Ground water tends to move laterally above the underlying beds of clay shale, but water tables seldom develop. This soil has a large water-storing capacity, but because of its fine texture, much of the moisture stored in the subsoil is made available to plants very slowly. For this reason, the soil is best suited to small grains that do not require large amounts of soil moisture late in summer.

Ebenezer loam is a productive soil and adapted to most crops grown in the county. It is somewhat deficient in phosphorus, and most crops yield better when phosphate fertilizer is used. Where this soil is eroded, or improperly managed, crops may show signs of nitrogen deficiency, particularly early in spring. If deep-rooted crops are grown, vigorous root development is essential during the early part of the growing season. Otherwise, in the dry part of the summer, root growth may be retarded by the fine-textured lower subsoil.

Ebenezer loam, 2 to 6 percent slopes (Ea; group 7B).—The profile of this mapping unit is the same as that described for Ebenezer loam. Range site: clay upland.

EBENEZER SILT LOAMS

These deep, friable, silt loams (pl. 2, *A*) occupy the gently undulating foot slopes of low ridges and hills. Their parent materials consist of friable, calcareous, uniformly silty wind deposits. These deposits usually average about 5 feet in thickness and overlie brown or reddish-brown, fine-textured, compact soils that developed on Loveland loess before they were buried by the present wind deposits. Occasionally the soils overlie bedrock.

Profile description for Ebenezer silt loams:

0 to 4 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 3.5/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

4 to 7 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3.5/1.5, moist) light silty clay loam; hard when dry, friable when moist; moderate coarse granular to very fine subangular blocky structure; slightly acid in reaction; the soil aggregates in this horizon have a thin coating of light gray on their surfaces during periods of dry weather.

7 to 16 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2.5, moist) light silty clay; extremely hard when dry, extremely plastic when wet; moderately developed medium and coarse blocky structure; nearly neutral in reaction.

16 to 28 inches, grayish-brown (10YR 5/2.5, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, very plastic when wet; strong medium blocky structure; nearly neutral in reaction.

28 to 36 inches, pale-brown (10YR 6/3, dry) to grayish-brown (10YR 5/2.5, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak coarse subangular blocky structure; calcareous; contains a few nodules of calcium carbonate.

36 to 55 inches, light yellowish-brown (10YR 6/4, dry) to brown (10YR 5/3, moist) silty clay loam; massive; calcareous; hard when dry, friable when moist; contains a few nodules of accumulated calcium carbonate and is mottled with strong brown stains.

Ebenezer silt loams are moderately well drained to well drained. Surface runoff is moderate under normal rainfall but increases as the physical condition of the soil deteriorates under improper management. A fair amount of surface water penetrates. Internal permeability, however, is moderately slow, and the underdrainage somewhat restricted. Ground water penetrates the underlying soil and shale bedrock slowly. Water tables sometimes develop but usually do not persist very long.

These soils are suited to most crops grown in the county, but their fine-textured subsoils may retard root development and supply soil moisture too slowly for best growth. Roots frequently penetrate to the claypan and then spread out laterally above it.

Most crops grown on these soils respond to applications of phosphate. The phosphate promotes fall root growth and hastens the maturing of wheat. If these soils are eroded or managed improperly, they are sometimes deficient in nitrogen, particularly in spring.

Ebenezer silt loam, 0 to 2 percent slopes (Eb; group 7A).—The profile of this mapping unit differs from that described for all Ebenezer silt loams in having a slightly thicker surface layer and slightly thicker and heavier subsoil layers. Range site: clay upland.

Ebenezer silt loam, 2 to 6 percent slopes (Ec; group 7B).—This mapping unit has the characteristics described as typical for Ebenezer silt loams. Range site: clay upland.

EBENEZER SILT LOAMS, COLLUVIAL

These soils have friable, crumb-structured surface layers. They occupy the lower foot slopes of hills and ridges, largely in the western part of the county. The foot slopes receive soil materials from higher areas, but soil development has kept pace with the depositional process. Consequently, these soils have thicker surface and upper subsoil layers and somewhat thinner lower subsoils than other Ebenezer soils.

Profile description for Ebenezer silt loams, colluvial:

0 to 8 inches, grayish-brown (10YR 5/2, dry) or very dark grayish-brown (10YR 3/1.5, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

8 to 13 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderately developed medium and coarse granular structure; slightly acid.

13 to 20 inches, dark grayish-brown (10YR 4/2.5, dry) or dark-brown (10YR 3/3, moist) silty clay loam; hard when dry, friable when moist; moderate very coarse granular and very fine subangular blocky structure; nearly neutral in reaction; surfaces of the aggregates have a light-gray (10YR 7/2) coating in dry periods.

20 to 30 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak to moderately developed medium blocky structure; nearly neutral in reaction.

30 to 36 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak coarse blocky structure; calcareous; contains a few concretions of calcium carbonate.

36 to 50 inches, pale-yellow (2.5Y 7/4, dry) or light yellowish-brown (10 YR 6/4, moist) silty clay loam; very hard to hard when dry, firm to friable when moist; massive; calcareous; contains a few calcium carbonate concretions and is mottled and stained with strong brown (7.5YR 5/6).

These soils are well drained to moderately well drained. Their internal permeability is moderately rapid, even though the lower subsoil layers are fine textured. Underdrainage is free and water tables do not develop. The soils are similar to Ebenezer silt loams in most respects, but the greater thickness of their surface soil and upper subsoil is more favorable to root development. These soils also receive additional supplies of moisture as runoff from the higher areas adjoining them.

Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes (Ed; group 7B).—This mapping unit is the same as that described as typical for Ebenezer silt loams, colluvial. Range site: clay upland.

Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes, eroded (Ee; group 7B).—This mapping unit, because of erosion, has a thinner surface layer than that described as normal. Fine-textured particles from the upper subsoil are mixed with the surface layer, but the degree of mixing has not been sufficient to change the texture of the layer. This soil is slightly lower in fertility and contains less organic matter than the uneroded Ebenezer silt loam, colluvial phase. Range site: clay upland.

EBENEZER SILTY CLAY LOAMS

These deep soils have friable surface layers that are finer textured than those of the other Ebenezer soils. They have developed on parent materials similar to those of the Ebenezer silt loams, but they occupy the steeper slopes of hills and ridges where erosion has been greater.

Profile description for uneroded Ebenezer silty clay loams:

0 to 10 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3.5/2, moist) silty clay loam; slightly hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; slightly acid.

10 to 14 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) light silty clay; hard when dry, firm when moist, very plastic when wet; weak to moderate fine subangular blocky structure; nearly neutral in reaction.

14 to 28 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak to moderate coarse and medium blocky structure; nearly neutral to slightly alkaline in reaction.

28 to 36 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak coarse subangular blocky structure; calcareous; contains nodules and streaks of calcium carbonate.

36 to 52 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; very hard when dry, friable when moist; massive; calcareous; streaked and mottled with reddish brown.

These are moderately well drained to well drained soils. Water infiltrates their finer textured surface layers more slowly than it does those of Ebenezer silt loams and Ebenezer loams. Consequently, more rainfall is lost as runoff. The fine texture and weak structural development contribute to their moderately slow internal permeability. Their fine texture also reduces the rate at which soil moisture is made available to plants. Underdrainage is restricted because ground water does not readily penetrate the underlying soil material and shale bedrock. Because the water moves laterally above the shale, water tables sometimes are present for short periods.

Because of the fine texture and compact subsoils, root development is often confined to the upper few inches of soil. Crops are therefore vulnerable to even short periods of drought. These soils have relatively poor qualities of tilth, and their structure is easily destroyed by improper tillage. The soils can be tilled only within a narrow range of moisture content. These soils are deficient in both nitrogen and phosphorus.

Ebenezer silty clay loam, 0 to 2 percent slopes, eroded (Ef; group 7A).—This mapping unit consists of areas that were once Ebenezer silt loam, but erosion has removed 2 to 4 inches of the original silt loam surface layer. During tillage, the texture of the surface layer has been changed to silty clay loam through mixing of the shallow surface layer with the heavier subsoil layers. This soil has a shallower zone in which roots can grow, is less fertile, and is more difficult to till than the Ebenezer silt loams. Additional erosion will make these changes more pronounced. Range site: clay upland.

Ebenezer silty clay loam, 2 to 6 percent slopes, eroded (Eg; group 7B).—In this mapping unit are areas that have lost all or nearly all of the silt loam surface soil. The silty clay loam upper subsoil of Ebenezer silt loam is the surface layer for this soil. Compared with Ebenezer silty clay loam, 0 to 2 percent slopes, eroded, this soil is less friable, has a thinner zone for root growth, is more difficult to till, and is more susceptible to erosion. Range site: clay upland.

Ebenezer silty clay loam, 2 to 6 percent slopes, severely eroded (Eh; group 7C).—This mapping unit consists of areas of Ebenezer silt loam from which erosion has removed all of the surface soil and a substantial part of the upper subsoil. In most areas, some

of the fine-textured lower subsoil is now included in the plow layer. The fertility, physical condition, and root zone of this soil have been seriously affected by erosion. Intensive management is needed to prevent further erosion. Range site: clay upland.

Ebenezer silty clay loam, 6 to 12 percent slopes, eroded (Ek; group 7B).—The profile of this mapping unit is similar to that described as normal for Ebenezer silty clay loams, but the thickness of the layers is less. The surface layer has a silty clay loam texture and coarse or moderately coarse structure. Range site: clay upland.

EDALGO SILT LOAMS

These are shallow to moderately deep upland soils that have granular surface layers. Their greatest extent is in the western part of the county, where they occur on the crests and shoulders of hills and ridges. They have developed from parent materials weathered from Cretaceous shales. The parent materials have been slightly modified by windblown silts, but no sharp boundaries exist between the two types of material.

Profile description for uneroded Edalgo silt loams:

0 to 6 inches, grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; weak fine granular structure; moderately acid.

6 to 16 inches, dark-brown (7.5YR 3/2, dry) or (7.5YR 3/3, moist) silty clay loam; hard when dry, friable when moist; moderately developed coarse granular or very fine subangular blocky structure; moderately acid.

16 to 22 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/4, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately developed medium and coarse blocky structure; moderately acid.

22 inches +, light-gray (10YR 7/1, dry) or gray (10YR 6/1, moist) noncalcareous clay shale.

Edalgo silt loam soils are well drained. In most areas surface runoff is fairly rapid and much of the rain falling on these soils is lost. Permeability is moderately slow to slow, and underdrainage is restricted by the underlying beds of shale. Because of the topographic position, water tables do not develop. Ground water moves laterally above the shale beds and appears as seeps and springs at lower levels. The water-storing capacity of these soils is low, and water in their subsoil is not readily available to plants.

Edalgo silt loams are not productive, but they are tilled in many areas because they occur with deeper soils. Nevertheless, in many locations, these soils occur along the perimeter of plowed areas and can be removed from tillage if fields are laid out along ground contours. When tilled, they are best suited to shallow-rooted crops, such as early maturing grains. They are deficient in phosphorus, and additional nitrogen is required to start legumes or to obtain profitable yields from small grains. The soils are moderately acid, and crops having low tolerances for acidity respond well when lime is applied.

These soils have fairly poor tilth. Their range of moisture content suitable for tillage is not wide.

Edalgo silt loam, 2 to 6 percent slopes (El; group 2A).—This mapping unit has the profile characteristics described as typical for Edalgo silt loams. Range site: clay upland.

Edalgo silt loam, 2 to 6 percent slopes, eroded (Em; group 2A).—This soil has lost from one-quarter to three-quarters of its surface layer through erosion, but in other characteristics it is similar to Edalgo silt loam soil, 2 to 6 percent slopes. Loss of soil fertility and organic matter have accompanied erosion. Part of the upper subsoil is now in the plow layer, but the texture of the layer has not been greatly changed. Range site: clay upland.

Edalgo silt loam, 6 to 12 percent slopes (En; group 2B).—This mapping unit differs from that described as normal for Edalgo silt loams in having a surface layer 3 to 4 inches thick, combined surface and subsoil layers about 12 inches thick, and a light-colored surface soil. Since this soil is on strong slopes, it is very susceptible to erosion. It is best used as native pasture, and even the pastured areas are often difficult to manage. Range site: clay upland.

Edalgo silt loam, 2 to 6 percent slopes, severely eroded (Eo; group 2B).—This soil has lost from three-quarters to all of its surface horizon. In places most, and in some places all, of the upper subsoil has been removed. The root zone is almost completely destroyed, and gullying is usually present. Range site: clay upland.

Edalgo silt loam, 6 to 12 percent slopes, severely eroded (Ep; group 2B).—All of the surface layer and most, if not all, of the upper subsoil have been removed by erosion. Gullying is nearly always present. Range site: clay upland.

ELMO SILT LOAMS

Elmo silt loams are deep, friable, reddish-brown soils of the upland. They have granular surface layers. They occur principally in the south-central and eastern parts of the county. Development has taken place in deep, uniformly silty, moderately fine textured parent materials, which are a mixture of windblown silts and outwash from Cretaceous shales and sandstones. The beds of parent material are normally more than 6 feet thick. They sometimes overlay coarse strata of waterworn channery material, but normally they are underlain by Cretaceous or Permian bedrock.

Profile description for Elmo silt loams:

0 to 6 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.

6 to 25 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; hard when dry, friable when moist; weak to moderately developed medium to fine subangular blocky structure; nearly neutral in reaction.

25 to 30 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; moderate fine subangular blocky structure; nearly neutral in reaction.

30 to 60 inches, yellowish-red (5YR 4/6, dry) or reddish-brown (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive to very weak coarse subangular blocky structure; neutral to slightly alkaline in reaction; contains a few small fragments of ironstone and sandstone.

Elmo silt loam soils are well drained. In most areas surface runoff is medium. Some water is lost, but there is good penetration of moisture. Permeability is moderate to moderately rapid, and underdrainage is free. These soils have a large water-storing capacity, and much of this water is available to plants.

Elmo silt loam soils are productive and suited to most crops grown in the county. They are best used for small grains, but row crops are profitably grown on them. Most crops yield better on these soils when phosphate is applied. Where these soils have been eroded, or managed less carefully, crops may require additional nitrogen early in spring.

Elmo silt loams have good qualities of tilth. Their moderately resistant surface soil and upper subsoil are easily tilled. Conventional machinery can be used on them throughout a wide range of moisture content.

Elmo silt loam, 2 to 6 percent slopes (Ev; group 10B).—This mapping unit has the same profile characteristics as those described for Elmo silt loams. Range site: loamy upland.

Elmo silt loam, 6 to 12 percent slopes (Ew; group 10D).—This mapping unit has a surface soil that is 4 to 6 inches in thickness. The combined surface and subsoil horizons are thinner than those described as normal for Elmo silt loams. Range site: loamy upland.

ELMO SILTY CLAY LOAMS

Elmo silty clay loams are deep, friable, reddish-brown soils of the uplands. They have silty clay loam surface layers. They occur with Elmo silt loams but differ from them in having lost the silt loam surface layer. In other characteristics and parent materials, these soils are very similar to Elmo silt loams.

Profile description for eroded Elmo silty clay loams:

0 to 18 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay loam; hard when dry, very friable when moist; weak medium granular structure; nearly neutral in reaction.

18 to 28 inches, reddish-brown (5YR 5/4, dry) or dark reddish-brown (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; weak to moderately developed medium subangular blocky structure; nearly neutral in reaction.

28 to 60 inches, yellowish-red (5YR 4/6, dry) or reddish-brown (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive; slightly alkaline in reaction; frequently contains a few fragments of ironstone and sandstone.

These soils have fine tilth. Their fine-textured surface layers however, cannot be tilled within so wide a range of soil moisture content as those of the Elmo silt loams. The soils also are destroyed more easily if improperly tilled.

Elmo silty clay loam, 2 to 6 percent slopes, severely eroded (Ex; group 10C).—The profile for this mapping unit is the same as described for eroded Elmo silty clay loams. Some gullying is nearly always present. Range site: loamy upland.

Elmo silty clay loam, 6 to 12 percent slopes, severely eroded (Ey; group 10E).—The profile for this mapping unit is the same as described for Elmo silty clay loams. Because of the steep slopes, it is susceptible to more severe sheet and gully erosion. The natural fertility of the soil is seriously depleted, and gullying is common. Range site: loamy upland.

ELMO LOAMS, TERRACE

These are deep, friable soils with granular surface layers. Their extent is in the southeastern part of the county, where they occur on high terraces bordering Gypsum Creek. The parent materials are friable sandy clay loam alluvial deposits that average more than 6 feet in thickness. The deposits are stratified in some areas and are old enough to have been leached of free calcium carbonate to depths of at least 5 feet.

Profile description for uneroded Elmo loams, terrace:

0 to 6 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) loam; slightly hard when dry, very friable when moist; moderate very fine granular structure; moderately acid.

6 to 22 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/3, moist) clay loam; hard when dry, friable when moist; moderately developed fine and medium subangular blocky structure; moderately acid.

22 to 33 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

33 to 60 inches, reddish-yellow (5YR 6/6, dry) or yellowish-red (5YR 5/6, moist) fine sandy clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

These are well-drained soils. Surface runoff is medium, so a fair amount of water enters the soil. Permeability is moderate to moderately rapid, and underdrainage is free. High water tables do not develop in these soils, nor are they subject to stream overflow. The soils have a large water-storing capacity, and most of the water stored within them is available to plants.

Elmo loams, terrace, are productive and well suited to all crops grown in the county. They are low in available phosphorus and are deficient in nitrogen where seriously eroded or badly depleted. They have good tilth and are easily worked throughout a wide range of moisture content.

Elmo loam, terrace phase, 2 to 6 percent slopes (Er; group 10B).—The profile for this mapping unit is the same as that described for Elmo loams, terrace. Range site: loamy upland.

Elmo loam, terrace phase, 2 to 6 percent slopes, eroded (Es; group 10B).—The characteristics of this mapping unit differ from those described as typical for Elmo loams, terrace, in having lost one-quarter to three-quarters of the surface layer and in tending toward a clay loam texture in the surface layer. The structure of the plow layer is therefore less favorable and the organic content and fertility are somewhat lower. Range site: loamy upland.

ELMO SILT LOAMS, TERRACE

These deep, friable, silty soils are developing on high terraces along the smaller streams in the western part of the county. These areas have a gently sloping relief, the direction of the slope being toward the present streams. The parent material in which these soils are developing is a deep, reddish-colored alluvium of silty clay loam texture. These beds show evidence of stratification and contain some lenses of Cretaceous shale and sandstone.

Profile description of Elmo silt loam, terrace variant:

0 to 6 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly acid.
6 to 16 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/3, moist) silty clay loam; granular; neutral in reaction.
16 to 24 inches, brown (7.5YR 5.5/4, dry) or brown (7.5YR 5/4, moist) silty clay loam; coarse granular; neutral in reaction.
24 to 32 inches, brown (7.5YR 4/4, dry) or dark-brown (7.5YR 5/4, moist) silty clay loam; coarse blocky structure; neutral in reaction.
32 to 48 inches, yellowish-red (5YR 5.5/6, dry) or (5YR 4/6, moist) clay loam; massive; neutral in reaction. A few carbonates may occur in this layer.
48 to 66 inches, yellowish-red (5YR 5.5/6, dry) or (5YR 5/6, moist) fine sandy clay loam; massive; neutral in reaction.

These soils are well drained. In most areas, surface runoff is slow, but permeability is moderate to moderately rapid and underdrainage is free. Most of the water falling on the soil during the rainy period enters the soils, is stored there, and is readily available to plants. Water tables normally do not develop on these soils, neither are they subject to stream overflow.

These soils are productive and suited to most crops grown in the county. The surface soil and upper subsoil possess fair qualities of tilth and are easily tilled. The soils are resistant to erosion when properly managed.

Elmo silt loam, terrace phase, 0 to 4 percent slopes (Et; group 10B).—The profile of this mapping unit is the same as that described as normal for Elmo silt loams, terrace. Range site: loamy upland.

Elmo silt loam, terrace phase, 0 to 4 percent slopes, eroded (Eu; group 10B).—This soil differs from Elmo silt loam, terrace phase, 0 to 4 percent slopes, in having lost one-quarter to three-quarters of the surface layer because of erosion. It has lost some of its fertility and organic matter and possesses less favorable qualities of tilth in the plow layer. Range site: loamy upland.

ENGLUND SILT LOAMS

These moderately deep, friable, silt loam soils of the uplands have granular surface layers and generally occur as small areas scattered on side slopes of hills and ridges throughout the county. They are most prevalent in the western and northern parts. Their fine-textured parent materials weathered from noncalcareous Cretaceous clay shales of the Dakota formation and rarely exceed 3 feet in thickness. The upper few inches of the soil profile may have been influenced by deposits of windblown loess.

Profile description for Englund silt loams:

0 to 4 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate very fine granular structure; nearly neutral in reaction.
4 to 12 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderate very coarse granular structure; nearly neutral in reaction.
12 to 20 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately developed medium and coarse blocky structure; nearly neutral in reaction.

20 to 32 inches, olive-gray (5Y 5/2, dry) or dark grayish-brown (2.5Y 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak coarse blocky structure; calcareous; contains a few nodules of calcium carbonate, mostly concentrated in the lower 4 inches.

32 inches +, olive-gray (5Y 5/2, dry) partially weathered noncalcareous clay shales.

Englund silt loams are well drained to moderately well drained. In most areas surface runoff is moderate, and a fair amount of water enters the soils. Permeability is moderately slow to slow. Underdrainage is restricted by the underlying shale beds. Ground water moves laterally above the shale beds and comes out at lower levels as seeps and springs. Although the water-storing capacity of these soils is large, much of the water in the fine-textured subsoil is made available to plants very slowly.

These moderately productive soils are best suited to small grains or shallow-rooted, drought-resistant crops. The claypan subsoils restrict root development and retard water movement in the soil during certain periods of the year.

Englund silt loams have only fair tilth. Their weakly resistant surface soils and upper subsoils are very susceptible to sheet and gully erosion.

Englund silt loam, 2 to 6 percent slopes (Ez; group 4A).—The profile of this mapping unit is that described as normal for Englund silt loams. Range site: clay upland.

Englund silt loam, 2 to 6 percent slopes, eroded (Eza; group 4B).—This soil has lost one-quarter to three-quarters of the surface layer through erosion. Some of the finer textured, less friable, upper subsoil material is now mixed with the plow layer. Range site: clay upland.

Englund silt loam, 2 to 6 percent slopes, severely eroded (Ezb; group 4C).—The profile of this soil differs from that typical for Englund silt loams in having lost three-quarters to all of its surface layer and most of its upper subsoil. The finer textured subsoil is mixed with the plow layer, but that layer still retains its silt loam texture. Gullying is nearly always present. The shallow solum limits root growth and makes it difficult to obtain profitable yields. Range site: clay upland.

ENGLUND SILTY CLAY LOAM, VERY SHALLOW VARIANT

This shallow, fine-textured soil occurs as isolated areas in the western third of the county. It has developed in place from outcrops of calcareous clay shales of the Dakota formation.

Profile description of Englund silty clay loam, very shallow variant:

0 to 3 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; weak to moderate medium granular structure; nearly neutral in reaction.

3 to 15 inches, very dark gray (10YR 3/1, dry) or (10YR 2.5/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak medium and coarse blocky structure; nearly neutral in reaction.

15 to 30 inches, grayish-brown (2.5Y 4/2, dry) or dark grayish-brown (2.5Y 3/2, moist) massive, calcareous beds of shale and clay.

This is a moderately well drained soil. Runoff is medium, but water moves slowly within the soil, and its movement is further restricted by the underlying shales. Water stored in the fine-textured subsoil is made available to plants slowly. Where the underlying shale beds outcrop, ground water from higher elevations flows out on this soil as seeps and springs.

This soil is unproductive and not suited to cultivation. Fields that contain much of it are best used for small grains.

Englund silty clay loam, very shallow variant, 2 to 6 percent slopes (Ezc; group 1A).—The profile of this mapping unit is the same as that described for the soil type. Range site: shallow land.

FALUN FINE SANDY LOAMS

These deep, fine sandy loams occur in small upland drainage channels throughout the county. They are developing in sandy parent materials washed from adjacent soils.

Profile description for Falun fine sandy loams:

0 to 14 inches, brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) fine sandy loam; soft when dry, very friable when moist; weak very fine granular to single-grained structure; slightly acid.

14 to 32 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; nearly neutral in reaction; horizon frequently contains thin lenses of silt and loam.

32 to 66 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/3, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; neutral to slightly alkaline in reaction; horizon is frequently stratified and is often mottled.

These soils are frequently overflowed, but their internal drainage is medium to rapid. Along the slopes of the channels, they also receive additional water from seeps and springs. They are moderately low in their water-storing ability, but the additional water received as seepage keeps pastures green and palatable late in summer. These soils are among the best in the county for pasture.

Falun fine sandy loam, 0 to 2 percent slopes (Fa; group 13A).—The profile of this mapping unit is the same as that described for Falun fine sandy loams. Range site: lowland.

Falun fine sandy loam, 2 to 6 percent slopes (Fb; group 13B).—This mapping unit occurs on steeper slopes than Falun fine sandy loam, 0 to 2 percent slopes, and it includes a few areas that have been slightly eroded. Range site: lowland.

FORE CLAYS

These deep, bottom-land soils have fine textures and granular surface layers. They occur in bottom lands throughout the county but are most extensive near Salina. They generally are on broad flats or backwash areas that have nearly level to gently sloping concave surfaces. They sometimes occur in old riverbeds or oxbows. Their parent material consists of fine-textured, calcareous alluvium. The alluvium varies in thickness but is nearly everywhere deeper than 6 or 7 feet.

Profile description for Fore clays:

0 to 4 inches, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (2.5Y 4/2, moist) clay; hard when dry, very plastic when wet; moderate coarse granular structure; calcareous.
4 to 12 inches, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (2.5Y 4/2, moist) clay; extremely hard when dry, extremely plastic when wet; massive; calcareous.
12 to 48 inches, light brownish-gray (2.5Y 6/2, dry) or dark grayish-brown (2.5Y 4/2, moist) clay; extremely hard when dry, extremely plastic when wet; massive; calcareous; contains a few calcium carbonate concretions and is mottled with brown and yellow stains.

These soils are poorly drained. In most areas surface runoff is very slow, and in many areas ponding occurs after rainfall. Permeability is slow, and underdrainage is very slow. In most areas water tables are high during the growing season. Some areas are covered by water the greater part of the growing season. The water-storing capacity of these fine-textured soils is large, but water slowly becomes available to plants.

Fore clays are moderately productive when drained sufficiently for crop growth. However, it is sometimes impossible to harvest crops on them because of summer rains. Since the soils are cold and wet, crops require additional nitrogen early in the growing season.

Because of their fine texture and inadequate drainage, these bottom-land soils have very poor tilth and can be cultivated only within a narrow range of moisture content. They are resistant to erosion but receive deposits of alluvial materials.

Fore clay, 0 to 2 percent slopes (Fc; group 17A).—The profile of this mapping unit is the same as that described for Fore clays. This soil occurs on concave nearly level to very gently sloping areas. Range site: lowland.

Fore clay, 2 to 6 percent slopes (Fd; group 17B).—The profile for this mapping unit is the same as that described for Fore clays. This soil occurs as long, narrow, irregular bodies along shallow drainageways and abandoned oxbows. These irregularly shaped areas are difficult to manage as separate units. Unless surface drainage can be assured, they are best used as permanent pasture, grassed waterways, or access areas to other parts of fields. Range site: lowland.

FORE SILTY CLAY LOAMS, DEEP OVER SILT

These deep soils of the bottom lands have friable, moderately fine textured surface layers. Their greatest acreage is in the valleys of the Smoky Hill and Solomon Rivers. They have nearly level to slightly concave slopes, except where they occur along drainage channels. The parent materials consist of moderately fine textured and fine textured calcareous alluvial deposits, which overlie stratified silty alluvium at depths between 36 and 60 inches.

Profile description for Fore silty clay loams, deep over silt:

0 to 10 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) silty clay loam; slightly hard when dry, friable when moist; weak fine granular structure; calcareous.
10 to 20 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown

(10YR 5/2, moist) silty clay loam; hard when dry, friable when moist; weak coarse granular structure; calcareous.

20 to 38 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) light silty clay or heavy silty clay loam; hard when dry, firm when moist; massive; calcareous.

38 to 50 inches +, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) massive, calcareous, stratified silts and very fine sands.

These are imperfectly drained to moderately well drained soils. In most areas runoff is slow, and ponding may occur after rainfall. Movement of water through the soil is moderately slow to slow. Underdrainage is free, however, and water tables normally do not develop. The water-storing capacity is large, but the moisture stored in the fine-textured subsoil is not readily available to plants.

These soils are moderately productive and suited to most crops grown in the county. Some crop loss may occur if these soils are wet at harvesttime. Since these soils are cold and wet in spring, crops may require additional nitrogen at this time. The soils have favorable tilth and are easily worked throughout a fairly wide range of moisture content. They are moderately resistant to water erosion but are somewhat susceptible to wind erosion.

Fore silty clay loam, deep over silt, 0 to 2 percent slopes (Fe; group 18A).—The profile of this soil is the same as that described for Fore silty clay loams, deep over silt. This soil occurs on nearly level to gently sloping slightly concave areas. Range site: lowland.

Fore silty clay loam, deep over silt, 2 to 6 percent slopes (Ff; group 18B).—This soil has the same profile characteristics as described for Fore silty clay loams, deep over silt, but it usually occurs as long, narrow, irregular-shaped areas along shallow drainageways and old oxbow channels. Because of their shape, these areas are difficult to manage as separate units. Range site: lowland.

GEARY SILT LOAMS

These are deep, friable, upland soils with crumb-structured surface layers. They occur on undulating to rolling slopes bordering the channel of the Smoky Hill River. The parent materials consist of friable, calcareous, uniformly silty wind deposits. These materials are more than 20 feet thick on the bluffs bordering the Smoky Hill River, but away from the river they rapidly thin to thicknesses of 4 or 5 feet. They usually overlie bedrock or buried soils that have developed on Loveland loess.

Profile description for Geary silt loams:

0 to 6 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

6 to 10 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular and very fine subangular blocky structure; slightly acid.

10 to 20 inches, brown (7.5YR 5/2, dry) or (7.5YR 4/2, moist) silty clay loam; hard when dry, friable when moist; weak medium subangular blocky structure; nearly neutral in reaction.

20 to 28 inches, brown (7.5YR 5/5, dry) or (7.5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; weak medium prismatic structure that breaks to moderately developed medium subangular blocky; nearly neutral in reaction.

28 to 60 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive; slightly alkaline in reaction.

Geary silt loams are well drained. In most areas surface runoff is medium to rapid, but a fair amount of water penetrates the soil. Permeability is moderately rapid, and underdrainage is free. High water tables do not occur. The water-storing capacity of these soils is large, and most of the water stored is available to plants.

Geary silt loams are productive and well suited to most crops grown in the county. They are slightly deficient in phosphorus, and areas that are eroded or that have not had proper management are deficient in nitrogen, particularly in spring.

Geary silt loam, 2 to 6 percent slopes (Ga; group 10B).—This soil has the same profile characteristics as those described for Geary silt loams. Range site: loamy upland.

Geary silt loam, 2 to 6 percent slopes, eroded (Gb; group 10B).—This soil has a thinner surface layer than that described for Geary silt loams. Erosion has caused depletion of organic matter and loss of natural fertility. The structural properties of the plow layer are less favorable than those of the uneroded Geary silt loam on slopes of 2 to 6 percent. Range site: loamy upland.

Geary silt loam, 6 to 12 percent slopes (Gc; group 10D).—This soil differs from that described as normal for Geary silt loams in having thinner horizons and slightly lighter surface soil. It usually occupies steep slopes on hill crests or on the sides of drainage channels. Range site: loamy upland.

Geary silt loam, 6 to 12 percent slopes, severely eroded (Gd; group 10E).—The profile of this soil differs from that described as normal for Geary silt loams in having lost three-quarters to all of the surface layer and, in places, most of the upper subsoil. The plow layer consists of the finer textured and less friable upper subsoil. The soil is seriously depleted, and gullying is present nearly everywhere. Range site: loamy upland.

HALL SILT LOAMS

These deep, friable, terrace soils occur throughout most of the river valleys in the county. They have developed in calcareous alluvial materials that are somewhat older than present flood plain deposits and are subject to less frequent overflow.

Profile description for uneroded Hall silt loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/1.5, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.

6 to 12 inches, dark-gray (10YR 4/1.5, dry) or very dark gray (10YR 3/1.5, moist) silty clay loam; hard when dry, very friable when moist; moderate coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

12 to 24 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, friable when moist; weak granular or fine subangular blocky structure; nearly neutral in reaction.

24 to 38 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silt loam; hard when dry, very friable when moist; massive; calcareous; contains a few concretions of calcium carbonate and moderate amounts of lime flour.

38 to 60 inches +, very pale brown (10YR 7/3, dry) to pale-brown (10YR 6/3, moist) silt loam; hard when dry, very friable when moist; calcareous; massive.

Hall silt loams are well drained. In most areas surface runoff is slow, though rapid enough to prevent ponding after rains. Permeability is moderately rapid to rapid, and underdrainage is free. High water tables generally do not occur in these soils. The water-storing capacity of these soils is large, and most of the water is available to plants.

These soils are very productive and suited to all crops grown in the county. They possess good qualities of tilth and can be tilled throughout a wide range of soil moisture content.

Hall silt loam, 0 to 2 percent slopes (Ha; group 18A).—This soil occurs on nearly level to very gently sloping terraces. Its profile is the same as that described for uneroded Hall silt loams. Range site: loamy upland.

Hall silt loam, 2 to 6 percent slopes (Hb; group 18B).—This soil differs from the phase on 0 to 2 percent slopes mainly in occurring as long, narrow, irregular-shaped areas along shallow drainageways. In these positions, it is difficult to manage as a separate unit. Range site: loamy upland.

Hall silt loam, 2 to 6 percent slopes, eroded (Hc; group 18B).—This soil differs from uneroded Hall silt loams in having a thinner surface layer. The soil has been changed very little by erosion, but the fertility and organic content are lower than for uneroded Hall silt loams. Range site: loamy upland.

HALL SILT LOAMS, BROWN SUBSOIL VARIANT

These deep, friable, silt loam soils occur principally in the eastern part of the county. Their greatest acreage is along Gypsum Creek. They occur on natural levees and in abandoned stream channels. The parent materials are more than 5 feet thick and consist of moderately stratified, friable, calcareous alluvium. The sand content in these materials increases below 4 feet.

Profile description for Hall silt loams, brown subsoil variant:

0 to 8 inches, grayish-brown (10YR 5/2, dry) to dark-gray (10YR 4/1, moist) silt loam; soft when dry, very friable when moist, slightly sticky when wet; fine crumb structure; slightly acid.

8 to 20 inches, grayish-brown (10YR 5/2, dry) to dark-gray (10YR 4/1, moist) silt loam or loam; soft when dry, very friable when moist, slightly sticky when wet; moderate medium crumb to moderate fine granular structure; nearly neutral in reaction; contains thin pale-brown (10YR 6/3, dry) bands that cannot be separated from the soil mass but which appear to be more sandy in texture.

20 to 30 inches, yellowish-brown (10YR 5/4, dry) or brown (10YR 4/3, moist) loam; soft when dry, very friable when moist, nonplastic when wet; massive to very weak fine granular structure; nearly neutral in reaction.

30 to 40 inches, light yellowish-brown (10YR 6/4, dry) to yellowish-brown (10YR 5/4, moist) fine sandy loam; soft when dry, very friable when moist, nonplastic when wet; massive; slightly alkaline in reaction.

40 to 48 inches +, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) heavy silt loam; slightly hard when dry, friable when moist, slightly plastic when wet; massive; uniformly calcareous but contains some mycelia of calcium carbonate.

These are well-drained soils. Their permeability is moderate to moderately rapid, and their underdrainage is free. Surface runoff is very slow, consequently, most rainwater enters the soil. These soils have only moderate water-storing capacity, but most of the water stored in them is available to plants. High water tables do not occur. The soils are productive, have good qualities of tilth, and are suited to most crops grown in the county. They are best suited to crops that do not require large amounts of moisture late in the summer.

Hall silt loam, brown subsoil variant, 0 to 2 percent slopes (Hd; group 18A).—The profile for this mapping unit is the same as that described for Hall silt loams, brown subsoil variant. The soil occurs on nearly level to gently sloping terraces. Range site: loamy upland.

Hall silt loam, brown subsoil variant, 2 to 6 percent slopes (He; group 18B).—The profile for this mapping unit is similar to that described as normal for Hall silt loams, brown subsoil variant. The soil occurs as narrow, irregular-shaped areas on gently to moderately undulating convex slopes. These areas are often difficult to manage as separate units. Range site: loamy upland.

HALLVILLE LOAMS

These moderately deep, dark-colored, friable soils of the uplands occur on undulating to steeply rolling areas, generally on the crests of winding ridges. They overlie beds consisting of waterworn fragments of sandstone and a moderately fine textured material. The largest acreage of these soils is in the central and eastern parts of the county.

Profile description for uneroded Hallville loams:

0 to 4 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) loam; slightly hard when dry, very friable when moist; moderate fine granular structure; slightly acid.

4 to 16 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silty clay loam; hard when dry, very friable when moist; weak very coarse subangular blocky structure; slightly acid; contains many ironstone and flat sandstone fragments.

16 to 40 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/3, moist) beds of stratified ironstone and flat sandstone fragments imbedded in a silty clay loam matrix; approximately neutral in reaction.

Hallville loams are somewhat excessively drained. In most areas surface runoff is very rapid and much of the water falling on the soils is lost. Permeability is rapid, and underdrainage is very free and open. The water-storing capacity of the soils is low, but the water stored is available to plants. Hallville loams are unproductive and somewhat deficient in phosphorus. If carefully managed, they are best suited to small grains or other crops that do not require large amounts of soil moisture late in the growing season.

Hallville loams are only moderately resistant to erosion. Wind and water remove the fine material and leave channery fragments and ironstones. Consequently, the soils are difficult to till and hard on farm machinery.

Hallville loam, 2 to 6 percent slopes (Hf; group 1A).—The profile of this mapping unit is the same as that described for uneroded Hallville loams. Range site: loamy upland.

Hallville loam, 2 to 6 percent slopes, eroded (Hg; group 1B).—The profile of this mapping unit differs from that for uneroded Hallville loams in having lost part of the surface layer through erosion. Some of the finer textured and gravelly subsoil has been mixed into the surface layer. The degree of mixing, however, has not been sufficient to change the texture of the plow layer. Range site: loamy upland.

Hallville loam, 6 to 12 percent slopes (Hh; group 1A).—This soil has a thinner surface layer than that described for uneroded Hallville loams; also, the surface soil usually is somewhat lighter in color and contains more channery material. This soil occurs on moderately steep to steep convex hill crests and ridges. Range site: loamy upland.

Hallville loam, 6 to 12 percent slopes, severely eroded (Hk; group 1B).—This soil differs from uneroded Hallville loams in having lost nearly all of the surface layer and, in places, most of the upper subsoil layer. The plow layer has much channery material and ironstone in it. The fertility of this soil is seriously depleted, and gullying is nearly always present. Range site: loamy upland.

HALLVILLE LOAMS, SHALLOW

These are shallow, moderately dark colored soils of the uplands. They have thin, friable and gravelly surface soils and subsoils and overlie Cretaceous shale bedrock. Usually the soils are on moderately steep, convex slopes on the crests of hills and ridges. They occur principally in the south-central and eastern parts of the county. The parent materials are at shallow depths and consist of thin beds of channery fragments in a matrix of silty clay loam or clay loam. The channery fragments were deposited as coarse alluvial debris and were imbedded in and covered by finer textured alluvial and colluvial materials.

Profile description for uneroded, shallow Hallville loams:

0 to 5 inches, dark brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) loam; slightly hard when dry, very friable when moist; moderate fine granular structure; nearly neutral in reaction.

5 to 8 inches, dark grayish-brown (10YR 4/1.5, dry) or very dark gray (10YR 3/1.5, moist) silty clay loam; hard when dry, friable when moist; massive to very weak coarse subangular blocky structure; nearly neutral in reaction; contains a few fragments of sandstone and shale.

8 to 24 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/2, moist) bed of coarse channery material imbedded in a matrix of silty clay loam; massive; nearly neutral in reaction.

24 inches +, unweathered or only partially weathered clay shale beds.

The shallow Hallville loams are generally excessively drained. In most areas surface runoff is very rapid and much of the water falling on the soils is lost. Permeability is moderately

slow, and drainage in the subsoil is restricted by the underlying shale. High water tables are not likely to develop, but ground water moves laterally above the shale beds and occurs as seeps and springs at lower levels. Since the water-storing capacity of these soils is low, the soils tend to be droughty most of the year. These shallow Hallville loams are unproductive when tilled and are very susceptible to wind and water erosion. Eroded areas generally are covered by channers and ironstone fragments.

Hallville loam, shallow phase, 2 to 6 percent slopes (Hl; group 1A).—The profile of this mapping unit is the same as that described for uneroded, shallow Hallville loams. Range site: loamy upland.

Hallville loam, shallow phase, 2 to 6 percent slopes, severely eroded (Hm; group 1B).—The profile of this soil differs from that described as typical for uneroded, shallow Hallville loams in having lost nearly all of the surface layer and, in some places, all of the surface layer and part of the upper subsoil. Shallow gullies are nearly always present. Range site: loamy upland.

Hallville loam, shallow phase, 6 to 12 percent slopes (Hn; group 1A).—This soil has a profile similar to that described for uneroded, shallow Hallville loams, but it has a somewhat thinner surface layer. The entire thickness of the soil above the clay shales usually does not exceed 18 inches. Range site: loamy upland.

Hallville loam, shallow phase, 6 to 12 percent slopes, severely eroded (Ho; group 1B).—The profile of this soil differs from that described as typical for uneroded, shallow Hallville loams in having lost nearly all of the surface layer and, in some areas, all of the surface layer and part of the subsoil. Gullying is nearly always present. Flat stone fragments and pieces of ironstone are more abundant in the surface layer than in other shallow Hallville loams. Range site: loamy upland.

HEDVILLE LOAMS

These are very shallow, stony soils of the uplands. They have thin, friable surface soils and thin, friable, medium-textured parent materials that overlie interbedded sandstones and sandy shales of the Dakota formation. They occupy the steeper convex slopes on the crests and shoulders of ridges or hills, principally in the western and northern parts of the county.

Profile description for uneroded Hedville loams:

0 to 10 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish brown (10YR 3/2, moist) loam; soft when dry, very friable when moist; weak fine granular structure; slightly acid; horizon contains a few scattered sandstone rocks.

10 inches +, partially decomposed Cretaceous sandstone and interbedded shale beds.

Hedville loams are well drained to excessively drained. Water soaks in rapidly, but the thin soils are quickly saturated. Consequently, surface runoff is large and much rainfall is lost. Permeability is moderately rapid, but ground water tends to move laterally above the beds of relatively impermeable shale and sand-

stone. Because of the steep slopes, high water tables do not occur in these areas. Hedville loams have a low water-storing capacity and are often droughty late in summer.

Hedville loams are unproductive. They are very susceptible to erosion and are best used as permanent pasture. Runoff from barren areas of Hedville loam soils causes erosion on surrounding soils. For this reason, if Hedville loam soils occur in fields with deeper soils, tillage should be directed around and not over the Hedville soils.

Hedville loam, 2 to 6 percent slopes (Hp; group 1A).—The profile of this mapping unit is the same as that described for uneroded Hedville loams. Range site: breaks.

Hedville loam, 2 to 6 percent slopes, eroded (Hr; group 1B).—This soil differs from that described for uneroded Hedville loams in having lost 1 to 4 inches of the surface layer through erosion. The depth of soil in which roots can grow is less and the water-holding capacity is lower than for uneroded Hedville loams. Runoff from this eroded soil may cause erosion on surrounding soils. Range site: breaks.

Hedville loam, 6 to 12 percent slopes (Hs; group 1A).—This soil has a thinner and more rocky profile than that described for uneroded Hedville loams. Range site: breaks.

HEDVILLE STONY LOAMS

These are very shallow and extremely stony soils of the uplands (pl. 2, *B*). They have developed in materials weathered from Cretaceous sandstone. They occupy similar positions and occur in the same general areas as Hedville loam soils but differ in their greater degree of stoniness.

Profile description for uneroded Hedville stony loams:

0 to 10 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) stony loam; many large sandstone rocks on the surface and within the soil; fine-textured material between rocks is slightly hard when dry, very friable when moist; weak granular structure; slightly acid.

10 inches +, only slightly weathered Cretaceous sandstone and interbedded shale.

These soils have excessive runoff, moderately rapid rates of infiltration, and very low water-holding capacities. They are very susceptible to erosion. Where they are eroded, runoff from these soils can easily damage surrounding soils.

Hedville stony loam, 2 to 6 percent slopes (Ht; group 1A).—The profile of this mapping unit is the same as that described for uneroded Hedville stony loams. Range site: breaks.

Hedville stony loam, 6 to 12 percent slopes (Hu; group 1A).—This soil has a thinner surface horizon than that described for uneroded Hedville stony loams. Range site: breaks.

HOBBS SILT LOAMS

These deep, dark-colored, alluvial soils are developing in small upland drains throughout the county. The greatest acreage, however, is in the western part of the county. The parent mate-

rials consist of friable and dominantly silty alluvium and colluvium which has been washed from surrounding soils. Hobbs soils are usually free of lime, but their reaction depends partially upon the character of the surrounding soils. In a few areas they are calcareous in the lower part of the profile. They generally are more than 5 feet thick and overlie bedrock.

Profile description for uneroded Hobbs silt loams:

0 to 6 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; weak to moderate fine granular structure; nearly neutral in reaction.

6 to 19 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, very friable when moist; weak very coarse subangular blocky structure that breaks to weak fine granular; nearly neutral in reaction.

19 to 28 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; weak coarse subangular blocky structure that breaks to weak very coarse granular; nearly neutral in reaction.

28 to 39 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/1.5, moist) silty clay; hard when dry, friable when moist; massive; nearly neutral in reaction.

39 to 60 inches +, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

Hobbs silt loams are usually well drained. Surface runoff is moderate to rapid in most areas. Permeability is moderate to moderately slow. The water-storing capacity of these soils is large, and most of the water stored is available to plants. Because of their position, much runoff from adjacent soils moves over these soils. They also receive much seepage water from surrounding upland areas. Springs and seeps occur along the margins of these soils.

Hobbs silt loams are productive, but they are subject to runoff from surrounding areas and frequently occur in long, narrow bodies that are difficult to till. Because of these difficulties, they are best used as pasture. Pasture remains green and succulent on these soils longer than on adjacent upland areas and supplies much of the best grazing late in summer. These soils are excellent sites for dams to provide water for stock.

Hobbs silt loam, 0 to 2 percent slopes (Hv; group 13A).—This soil occurs on gentle concave slopes. Its profile is the same as that described for uneroded Hobbs silt loams. In a few areas the lower part of the profile is calcareous. Range site: lowland.

Hobbs silt loam, 0 to 2 percent slopes, eroded (Hw; group 13A).—This soil differs from that described for uneroded Hobbs silt loams in having lost 2 to 4 inches of the surface layer through erosion. Plowing has mixed some of the finer textured upper subsoil in with the surface layer, but not enough to alter the texture. Range site: lowland.

Hobbs silt loam, 2 to 6 percent slopes (Hx; group 13B).—The profile of this mapping unit is the same as that described for uneroded Hobbs silt loams. In a few areas the lower part of the profile is calcareous. The soil occurs on convex slopes. Range site: lowland.

Hobbs silt loam, 2 to 6 percent slopes, eroded (Hy; group 13B).—The profile of this mapping unit is similar to that described for uneroded Hobbs silt loams. It differs in having lost 2 to 4 inches of the surface layer. Plowing has mixed some of the finer textured upper subsoil with the surface soil. Range site: lowland.

HOBBS SILT LOAM, LIGHT-COLORED VARIANT

This deep, friable, silty soil is developing on alluvial fans at the mouths of small streams draining areas of Ninnescah shale and limestones. Surface drainage is adequate, but subsurface drainage is dependent on the character of the underlying materials. The soil has a moderately high rate of water infiltration and a good water-storing capacity. Areas of this soil are subject to frequent flooding.

Profile description of Hobbs silt loam, light-colored variant:

0 to 17 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3/2, moist) silt loam; friable; neutral in reaction.

17 to 24 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/2, moist) silty clay; friable; massive; calcareous.

24 to 48 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/2, moist) light silty clay; massive; calcareous.

Hobbs silt loam, light-colored variant, 0 to 2 percent slopes (Hz; group 13A).—The profile of this mapping unit is the same as that described as normal for Hobbs silt loam, light-colored variant. Areas of this soil have a gently sloping convex relief. They are subject to frequent flooding and may be damaged by sheet erosion unless protected. Range site: lowland.

HUMBARGER LOAMS

These deep, light-colored soils of the bottom lands have developed in friable, calcareous, stratified silty alluvium. The alluvial materials, usually more than 7 feet thick, overlie other alluvial deposits or buried soils. The Humbarger soils occur on the nearly level to very gently undulating convex surfaces of recent flood plains and low terraces. Many areas are on natural levees along present and abandoned stream channels. The greatest acreages are in the valley of the Saline and Smoky Hill Rivers in the vicinity of Salina.

Profile description for uneroded Humbarger loams:

0 to 7 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) loam; slightly hard when dry, very friable when moist; weak fine crumb structure; calcareous.

7 to 26 inches, light brownish-gray (10YR 6/2.5, dry) or grayish-brown (10YR 5/2.5, moist) silt loam; slightly hard when dry, friable when moist; massive; calcareous.

26 to 60 inches, very pale brown (10YR 7/3, dry) or pale-brown (10YR 6/3, moist) loam; slightly hard when dry, very friable when moist; massive; calcareous.

Humbarger loams are well drained. In most areas, surface runoff is slow. However, runoff is sufficiently rapid to prevent ponding. Permeability is moderate to rapid, and underdrainage is free except in those few areas underlain by fine-textured alluvial materials. Their water-storing capacity is moderate, and most of the water stored is available to plants. High water tables generally do not occur.

Humbarger loams are fertile, possess good qualities of tilth, and are suited to most crops grown in the area. They are usually deficient in nitrogen, unless a legume crop has been grown in the crop rotation. They are easily tilled throughout a fairly wide range of moisture content. They are only moderately resistant to erosion and are particularly susceptible to wind erosion if poorly managed.

Humbarger loam, 0 to 2 percent slopes (Hza; group 21A).—The profile of this soil is the same as that described for uneroded Humbarger loams. Range site: lowland.

Humbarger loam, 2 to 6 percent slopes (Hzb; group 21B).—This mapping unit has the same profile characteristics as those described for uneroded Humbarger loams. It occurs on moderately undulating convex slopes along the sides of drainage channels and on natural levees adjacent to river channels. In some areas it occurs as long, narrow, irregular-shaped bodies that are difficult to manage as separate units. Range site: lowland.

Humbarger loam, 2 to 6 percent slopes, eroded (Hzc; group 21B).—This soil differs from uneroded Humbarger loam soils in having lost 2 to 3 inches of the surface layer. The soil is less fertile and contains less organic matter than the uneroded Humbarger loam on slopes of 2 to 6 percent. In many areas it occurs in long, narrow, irregular-shaped areas along shallow drainageways. Range site: lowland.

HUMBARGER SILT LOAMS

These deep, light-colored soils of the bottom lands have developed in friable, calcareous, stratified silty alluvium. The alluvium usually is more than 5 feet thick; it overlies other alluvial deposits and, in some areas, buried soils. Although Humbarger silt loams are present throughout the county, their greatest acreage is on the flood plains along the Smoky Hill, Saline, and Solomon Rivers.

Profile description for uneroded Humbarger silt loams:

0 to 11 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine granular structure; calcareous.

11 to 16 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous.

16 to 26 inches, light-gray (10YR 7/2, dry) or light grayish brown (10YR 6/2, moist) light silty clay loam; hard when dry, friable when moist; massive; calcareous.

26 to 60 inches, light-gray (10YR 7/2, dry) or pale-brown (10YR 6/3, moist) silt loam; hard when dry, very friable when moist; massive; calcareous.

Humbarger silt loams are well drained. Surface runoff is very slow in most areas, but the soils are rarely ponded. Permeability is moderate to moderately rapid, and underdrainage is free, except in a few areas where fine-textured alluvial materials underlie these soils at depths of 5 feet or more. The water-storing capacity of these soils is large, and most of the water stored is available to plants. High water tables generally do not develop.

Humbarger silt loams are productive and suited to all crops grown in the county. They are subject to occasional stream overflow, but damage to crops usually is small. The soils are easily tilled throughout a fairly wide range of moisture content, but they are moderately susceptible to wind erosion if managed improperly.

Humbarger silt loam, 0 to 2 percent slopes (Hzd; group 18A).—The profile of this mapping unit is the same as that described for uneroded Humbarger silt loams. Range site: lowland.

Humbarger silt loam, 2 to 6 percent slopes (Hze; group 18B).—The profile characteristics for this soil are similar to those described for uneroded Humbarger silt loams. The soil frequently occurs as long, narrow, irregularly shaped areas that are difficult to manage separately. Range site: lowland.

Humbarger silt loam, 2 to 6 percent slopes, eroded (Hzf; group 18B).—The profile of this mapping unit is similar to that described for uneroded Humbarger silt loams, but 4 to 5 inches of the surface layer has been removed by erosion. This soil frequently occurs along the sides of drainage channels that have cut into areas of Humbarger loam soils. In these positions the narrow soil bodies are difficult to manage separately. In some parts of the county this soil occurs in gently sloping areas on natural levees. Range site: lowland.

Humbarger silt loam, 2 to 6 percent slopes, severely eroded (Hzg: group 18B).—This soil differs from uneroded Humbarger silt loams in having lost 7 inches or more of its surface layer. It is lower in fertility and organic-matter content than the uneroded Humbarger silt loam on comparable slopes and is more susceptible to erosion. It often occurs as irregular-shaped areas along stream channels and the sides of shallow drainageways. Range site: lowland.

IDANA SILT LOAMS

These deep, dark-colored, claypan soils occur principally on uplands in the southern and eastern parts of the county. They occupy the foot slopes of hills and ridges and at depths of 4 or 5 feet are underlain by partially weathered, calcareous, clay shales of Permian age. The parent materials consist of weathered clay shales of the Wellington formation and wind-deposited silts.

Profile description for uneroded Idana silt loams:

0 to 6 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/1.5, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.

6 to 14 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular to very fine subangular blocky structure; nearly neutral in reaction.

14 to 31 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/1.5, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate fine and medium blocky structure; slightly alkaline in reaction.

31 to 39 inches, yellowish-brown (10YR 5/4, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak to moderate coarse blocky structure; calcareous; contains a few concretions of calcium carbonate.
39 to 50 inches, pale-yellow (5Y 7/3) partially weathered calcareous clay shales of Permian age.

Idana silt loams are well drained. In most areas surface runoff is medium, and a large part of the normal rainfall enters the soil. Because the subsoil has a coarse blocky structure, permeability is moderate, even though the subsoil is fine textured. Underdrainage is free, but ground water moves slowly above the underlying shale beds. The slope generally is sufficient, however, to prevent the development of water tables.

Idana silt loams are moderately productive but do not hold enough moisture for some crops late in summer. Unless plant roots grow vigorously, the heavy clay subsoil restricts root development. If carefully managed, these soils possess fair qualities of tilth and are moderately resistant to erosion.

Idana silt loam, 2 to 6 percent slopes (Ia; group 6A).—The profile of this mapping unit is the same as that described for uneroded Idana silt loams. Range site: clay upland.

Idana silt loam, 2 to 6 percent slopes, eroded (Ib; group 6B).—This soil differs from Idana silt loam, 2 to 6 percent slopes, in having lost 2 to 3 inches of the surface layer. During tillage, some of the finer textured upper subsoil has mixed with the surface layer. This soil is more difficult to work than the uneroded Idana silt loam on slopes of 2 to 6 percent, and it cannot be worked in so wide a range of moisture content. Range site: clay upland.

IDANA SILTY CLAY LOAMS

These deep, moderately dark colored soils mainly occupy the steeper foot slopes of hills and ridges. Idana silt loam soils once occupied these areas, but erosion removed the silt loam surface layer and exposed the silty clay loam subsoil. The parent materials of the Idana silty clay loams thus formed are similar to those of Idana silt loams, but the influence of windborne silts is less pronounced in the upper horizon.

Profile description for eroded Idana silty clay loams:

0 to 10 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10 YR 4/2, moist) silty clay loam; hard when dry, friable when moist; weak very coarse granular structure; nearly neutral in reaction.
10 to 27 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate medium to coarse blocky structure; slightly alkaline in reaction; calcareous.
27 to 34 inches, yellowish-brown (10YR 5/4, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak coarse blocky structure; calcareous; contains a few concretions of calcium carbonate.
34 to 60 inches +, pale-yellow (5Y 7/3) partially weathered calcareous clay shales of Permian age.

Idana silty clay loams are well drained and well oxidized. Moisture soaks in moderately rapidly if the natural structure of the soils has not been destroyed. Because of the coarse blocky

structure of the subsoil horizons, permeability is moderate, even though the subsoils are fine textured. The rate of permeability is greater when the soils are dry and the structure is most pronounced. Underdrainage is restricted by the underlying beds of shale. Ground water moves laterally above these beds. The water-storing capacity of these soils is large, but the moisture held in the fine-textured subsoil is only slowly available to plants.

Idana silty clay loams are less productive than Idana silt loams because part of the natural fertility has been lost through erosion. The soils are best suited to shallow-rooted crops that mature early or to crops tolerant of long periods of drought late in the growing season. They are deficient in both phosphorus and nitrogen.

Idana silty clay loams possess fair tilth but can be tilled only within a narrow range of moisture content. They are susceptible to wind and water erosion. Tillage that leaves the surface soil loose and powdery results in blowing and washing.

Idana silty clay loam, 2 to 6 percent slopes, severely eroded (Ic; group 6C).—The profile of this mapping unit is similar to that described for eroded Idana silty clay loams, but 4 inches or more of the surface layer has been removed by erosion. The plow layer consists almost entirely of the finer textured, less friable, materials from the upper subsoil, and in some areas the plow layer includes fine-textured, plastic materials from the lower subsoil. Gullying is nearly always present. Fertility has been seriously depleted, and the tilth is less favorable than described for eroded Idana silty clay loams. Range site: clay upland.

Idana silty clay loam, 6 to 12 percent slopes, eroded (Id; group 6B).—The profile of this mapping unit is similar to that described for eroded Idana silty clay loams, but 2 to 4 inches of the surface layer have been removed by erosion, and the entire solum is less thick. Because of the steep slopes, this soil is very susceptible to erosion. Range site: clay upland.

KIPP SILT LOAMS

These are moderately deep, moderately dark colored, friable soils of the uplands. They occupy undulating to steeply rolling areas on the crests and shoulders of hills and ridges. The greatest acreage is in the southern and eastern parts of the county. The soils have developed in fine-textured, calcareous parent materials that weathered from the underlying clay shales of the Wellington formation. They are underlain at depths of 20 to 24 inches by the unweathered or partially weathered clay shales.

Profile description for Kipp silt loams:

0 to 4 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; soft when dry, very friable when moist; weak to moderate fine crumb structure; nearly neutral in reaction.

4 to 12 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; slightly hard when dry, friable when moist; strong fine and very fine granular structure; nearly neutral in reaction.

12 to 20 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, very friable when moist; moderate very fine subangular blocky structure; nearly neutral in reaction.

20 to 23 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive to very weak coarse subangular blocky structure; calcareous; contains concretions of calcium carbonate and moderate amounts of finely disseminated lime; also contains many fragments of partially weathered shale.

23 inches +, partially weathered strongly calcareous clay shales of Permian age.

Kipp silt loams are well drained to somewhat excessively drained. Both runoff and permeability are moderately rapid, but underdrainage is restricted by the underlying beds of shale. Ground water flows laterally above these beds to emerge as seeps and springs at lower levels where the beds are exposed. Generally the slopes are sufficient to prevent the occurrence of water tables. Because Kipp silt loams have only moderate depth and moderate water-holding capacities, they are often droughty late in summer.

Kipp silt loams are moderately productive but are best suited to early maturing grains or shallow-rooted, drought-resistant crops. Their shallow depth to bedrock limits the growth of plant roots. Native pastures grow poorly during the hot summer months. Overgrazing at this time can seriously deplete or lower the quality of the stand.

Kipp silt loams have fair tilth but are very susceptible to wind and water erosion. Because they are shallow, even slight erosion can seriously damage them. Unless controlled, the rapid runoff from Kipp soils causes severe erosion on the deeper soils that surround them.

Included with Kipp silt loam soils are a few small areas in which the parent materials are strongly influenced by local windblown sands. In these areas the texture is fine sandy loam in the upper layer, loam to silty clay farther down, and silty clay loam immediately above the underlying shale.

Kipp silt loam, 2 to 6 percent slopes (Ka; group 5A).—The profile of this mapping unit is the same as that described for Kipp silt loams. Range site: loamy upland.

Kipp silt loam, 6 to 12 percent slopes (Kb; group 5A).—The profile of this mapping unit is similar to that described for Kipp silt loams; however, the surface soil is usually lighter in color and the entire solum is generally somewhat thinner. The bedrock shales occur at depths of 14 to 18 inches. Range site: loamy upland.

KIPP SILTY CLAY LOAMS

These moderately deep and moderately dark colored soils occupy areas that were Kipp silt loams before all the silt loam surface soil was lost through erosion. The parent materials are the same, but these silty clay loams generally occur on the steeper parts of slopes.

Profile description for eroded Kipp silty clay loams:

0 to 6 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; slightly hard when dry, friable when moist; medium fine granular structure; nearly neutral in reaction.

6 to 14 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, friable when moist; moderate very fine subangular blocky structure; nearly neutral in reaction.

14 to 18 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains calcium carbonate as concretions and in finely disseminated forms; also contains fragments of partially disintegrated shale.

18 inches +, partially weathered, calcareous, Permian shale.

Kipp silty clay loams have drainage characteristics similar to those of Kipp silt loams. They differ in having lower rates of infiltration and lower water-storing capacities. These differences may be explained by their finer textures, the poorer structure of their surface layer, and the shallower depth of the solum.

Kipp silty clay loams are less productive than Kipp silt loams. They have poor tilth, are very susceptible to wind and water erosion, and require phosphorus and nitrogen for the optimum growth of most crops.

Kipp silty clay loam, 2 to 6 percent slopes, eroded (Kc; group 5A).—The profile of this mapping unit is the same as that described for eroded Kipp silty clay loams. Range site: loamy upland.

Kipp silty clay loam, 2 to 6 percent slopes, severely eroded (Kd; group 5B).—This soil differs from that described for eroded Kipp silty clay loams in having had most of the surface layer removed by erosion. Gullying is nearly always present in these areas. Range site: loamy upland.

Kipp silty clay loam, 6 to 12 percent slopes, severely eroded (Ke; group 5B).—This soil differs from the phases of Kipp silty clay loam already described in having lost most of the surface layer through erosion and, in some areas, much of the subsoil. Severe gullying is usually present in these areas. Most areas of this soil are no longer cultivated and are in various stages of regrassing. Some severely eroded pasture areas are on this soil. Range site: loamy upland.

KIPSON SILT LOAMS

These very shallow, moderately light colored soils of the uplands occupy the crests and shoulders of hills and ridges. They occur mainly in the eastern and central parts of the county. They are developing in imperfectly weathered clay shales and interbedded limestones that overlie partially weathered calcareous shale and limestone at depths of 10 to 12 inches.

Profile description for Kipson silt loams:

0 to 5 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silt loam; soft when dry, very friable when moist; weak fine crumb structure; calcareous.

5 to 10 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) light silty clay loam; slightly hard when dry, very friable when moist; weak fine granular structure; calcareous; contains fragments of partially weathered shale and limestone.

10 inches +, partially weathered calcareous clay shales and thin interbedded limestones of Permian age.

Kipson silt loams are excessively drained. In cultivated areas, runoff is very rapid. Infiltration and permeability are moderately rapid. Underdrainage is restricted by the beds of clay shale. Ground water moves laterally above the shale beds, but water tables do not occur, because the slopes are steep.

Kipson silt loams are unproductive when cultivated and are easily damaged by erosion. They often occur along with other tilled soils in fields and in such positions are difficult to manage separately. They are poorly supplied with organic matter and are low in phosphorus and nitrogen. Their grazing capacity generally is low during late summer and in fall. In uneroded areas, their friable surface soils and subsoils can be tilled throughout a fairly wide range moisture content.

Kipson silt loam, 2 to 6 percent slopes (Kh; group 1A).—The profile of this mapping unit is the same as that described for Kipson silt loam soils. Included are a few small areas in which limestone fragments make up a significant part of the soil mass. Range site: shallow land.

Kipson silt loam, 6 to 12 percent slopes (Kk; group 1A).—The characteristics of this soil are similar to those described as typical for Kipson silt loams, but this soil is frequently more shallow. A few areas are included in which limestone fragments make up a significant part of the soil. Range site: shallow land.

Kipson silt loam, over 12 percent slopes (Kl; group 1A).—This soil rarely has more than 8 inches of friable materials over bedrock. Only a few areas have been tilled. Range site: shallow land.

KIPSON SHALY SILT LOAMS

These very shallow, light-colored soils of the uplands have developed in areas once occupied by Kipson silt loam. The silt loam surface layer of those soils has been lost through erosion. The shaly silt loam is now at the surface, and usually only a few inches of loose soil material remains over the bedrock shales. The soils generally are on the steeper parts of slopes.

Profile description for Kipson shaly silty loams (eroded):

0 to 8 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; soft when dry, very friable when moist; weak very fine granular structure; calcareous; the horizon contains many fragments of partially weathered shale and limestone.

8 inches +, calcareous partially weathered beds of Permian clay shale.

Much of the water falling on these soils is lost as runoff. The rate of infiltration is slow. The water-storing capacity is very low. The soils are unproductive. For most crops the soils are not deep enough to permit satisfactory root growth. The soils are tilled as a matter of convenience where they occur with other soils that are used for crops. When tilled, they are very susceptible to erosion.

Kipson shaly silt loam, 2 to 6 percent slopes, eroded (Kf; group 1B).—The profile of this mapping unit is the same as that described for Kipson shaly silt loam (eroded). Range site: shallow land.

Kipson shaly silt loam, 6 to 12 percent slopes, severely eroded (Kg; group 1B).—The profile of this mapping unit is similar to that described for Kipson shaly silt loams (eroded), but the soil is more shallow because of the severe degree of erosion. The soil is unproductive, and reestablishment of grass is a problem. Range site: shallow land.

LANCASTER LOAMS

These deep, friable, medium-textured soils of the uplands occur on the sides and foot slopes of hills and ridges, mainly in the western part of the county, where they are one of the most important kinds of soils. They are developing in friable, sandy clay loam materials that weathered from bedrock of Dakota sandstone and shale. The parent materials are underlain by unweathered or partially weathered sandstones and sandy clay shales at depths of about 5 feet. In some localities the surface layers have been influenced by loess materials to depths of 12 inches.

Profile description for uneroded Lancaster loams:

0 to 5 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2/2, moist) loam; soft when dry, very friable when moist; moderate fine crumb or granular structure; moderately acid.

5 to 14 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; moderately acid.

14 to 22 inches, dark-brown (7.5YR 4/4, dry) or reddish-brown (5YR 4/4, moist) clay loam; hard when dry, friable when moist; weak coarse prismatic structure that breaks to moderate coarse and medium subangular blocks; slightly acid.

22 to 36 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) clay loam; hard when dry, friable when moist; moderate to weak coarse subangular blocky structure; nearly neutral in reaction.

36 to 66 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) sandy clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

Lancaster loams are well drained. In most areas runoff is medium and a moderate proportion of the water enters the soil profile. The rate of infiltration depends upon the physical condition of the surface soil. Permeability is moderately rapid, and underdrainage is free, but ground water moves laterally above the underlying shale beds. Slopes are steep enough to prevent the development of water tables. The water-storing capacity of these soils is large, and most of the moisture they store is available to plants.

Lancaster loams are best suited to crops that are tolerant of moderate soil acidity. Lime must be added to obtain the best stands of crops such as sweetclover and alfalfa. The soils are deficient in available phosphorus and, where they have been eroded or depleted and legumes have not been used in the crop rotation, are also deficient in available nitrogen. When Lancaster loams are carefully managed, their surface soils and subsoils are friable and easily tilled within a fairly wide range of moisture content. The soils are moderately resistant to erosion but must be protected to prevent water erosion, particularly gullying.

Lancaster loam, 2 to 6 percent slopes (Lh; group 3A).—The profile of this mapping unit is the same as that described for uneroded Lancaster loams. Range site: loamy upland.

Lancaster loam, 2 to 6 percent slopes, eroded (Lk; group 3A).—The profile of this mapping unit differs from that described for uneroded Lancaster loams in having lost 2 to 3 inches of the surface layer through erosion. Some of the finer textured subsoil material has been incorporated in the surface soil during cultivation. Range site: loamy upland.

Lancaster loam, 2 to 6 percent slopes, severely eroded (Ll; group 3C).—This soil differs from that described for uneroded Lancaster loams in having lost most of the surface layer and, in some areas, all of the surface soil and part of the upper subsoil. The inclusion of fine-textured subsoil material in the surface layer has produced a heavy loam plow layer. The soil is less fertile, cannot be worked so easily, and is more susceptible to erosion than other Lancaster loams on slopes of 2 to 6 percent. Gullying is nearly always present in areas of this soil. Range site: loamy upland.

Lancaster loam, 6 to 12 percent slopes (Lo; group 3B).—This soil differs from that described as typical for uneroded Lancaster loams in having somewhat thinner and lighter colored surface soil and less combined thickness of surface soil and subsoil. These areas occur on the higher parts of slopes and on the crests of hills, where they are more susceptible to erosion and more difficult to manage than the Lancaster loams on slopes of 2 to 6 percent. Range site: loamy upland.

Lancaster loam, 6 to 12 percent slopes, severely eroded (Lp; group 3C).—The surface layer of this soil, and, in many places, part of the upper subsoil have been removed by erosion. In most areas the present surface layer has a heavy loam texture. Included in this mapping unit are a few small areas that have heavier textured subsoil than that described as typical for uneroded Lancaster loam soils. Almost all of this soil is gullied. Range site: loamy upland.

LANCASTER LOAMS, SHALLOW

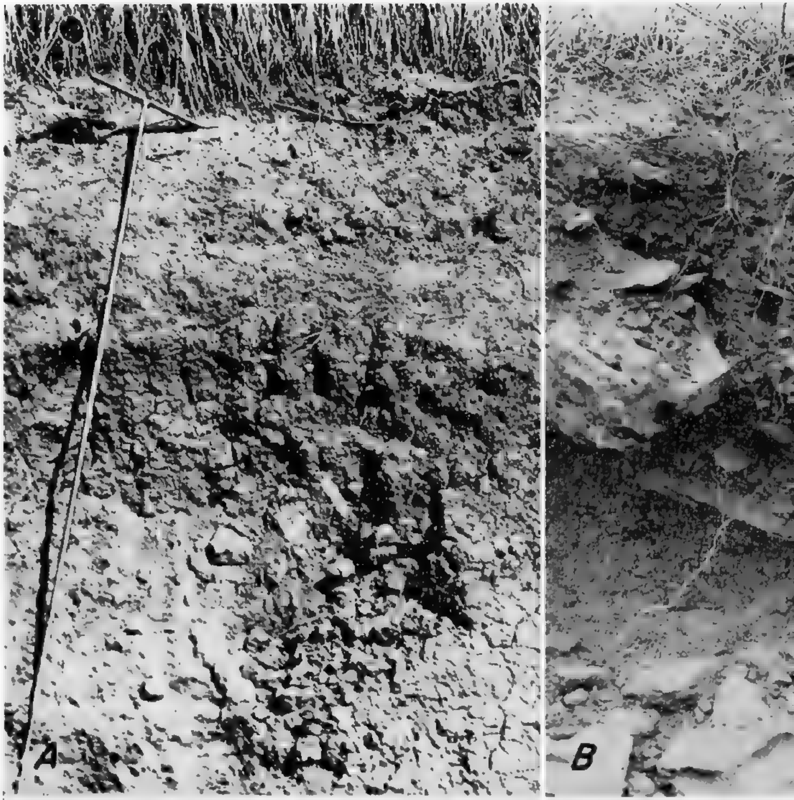
These moderately deep, friable, medium-textured soils of the uplands have their greatest acreage in the western and northern parts of the county. They generally occur on the crests of hills and ridges and are underlain by interbedded Dakota sandstones and shales at depths of 22 to 25 inches. The sandy clay loam parent materials have weathered from the underlying rock. In some areas the texture in the upper few inches of the surface layer has been influenced by loess deposits.

Profile description for uneroded shallow Lancaster loams:

0 to 9 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2/2, moist) loam; soft when dry, very friable when moist; moderate fine crumb structure; moderately to slightly acid.

9 to 18 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 3/2, moist) heavy loam or light clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; moderately to slightly acid.

Wheat growing on Bonaccord silty clay loam-Solonetex complex. Barren ar

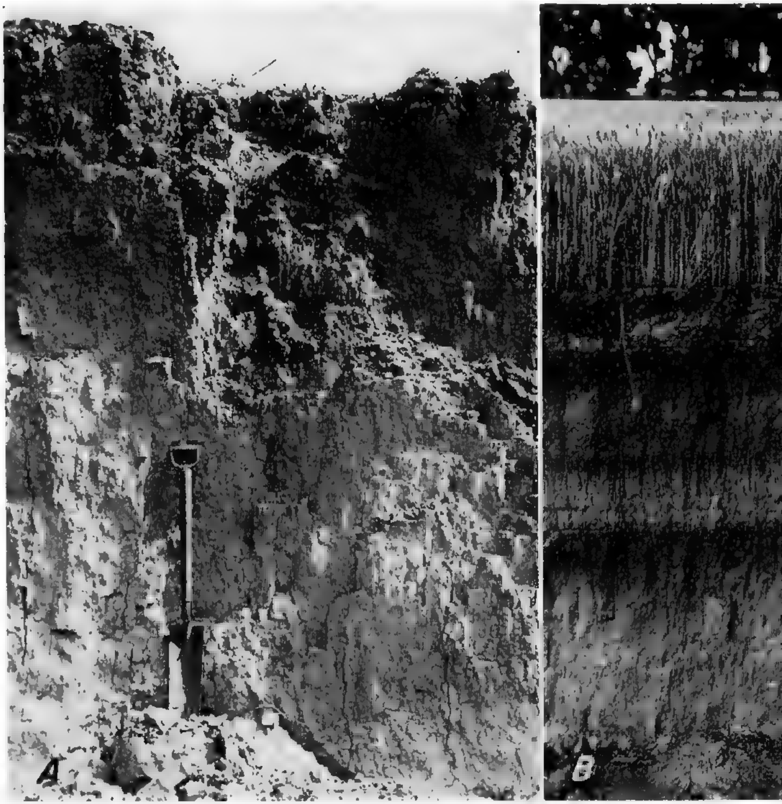


A, Profile of Ebenezer silt loam, showing fine texture and block

B, Profile of Hedville stony loam.

A, **Wheat growing on terraces built to help control erosion.**

B, **Landscape showing influence of topography on soil development; parent material weathered from sandstones and shale of Dakota formation.**



A, Profile showing uniform color and vertical cleavage of Lockhard

B, Dark-colored bands mark the surface layers of old soils buried b

18 to 25 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) clay loam; hard when dry, friable when moist; weak to moderate coarse subangular blocky structure; slightly acid.

25 inches +, interbedded sandstone and sandy shales of Cretaceous age.

The shallow Lancaster loams are well drained. In most areas, surface runoff is medium and much of the water enters the soil. Permeability is rapid, but underdrainage is restricted by the underlying beds of sandstone and shale. Ground water flowing above the bedrock strata emerges as seeps and springs at lower levels. Because of their thinness, these soils are often droughty late in summer.

Shallow Lancaster loam soils are moderately productive if not eroded, but they are best suited to drought-resistant crops that are tolerant of moderate soil acidity. Lime must be added to assure good stands of legumes. The soils are deficient in phosphorus. Where they have been eroded or seriously depleted, they are also deficient in available nitrogen. The depth of root growth is limited by the underlying strata. If carefully managed, the surface soils and upper subsoil are friable and easily tilled through a fairly wide range of moisture content. The soils are very susceptible to erosion and, because of their shallow depth, are easily damaged by erosion.

Lancaster loam, shallow phase, 2 to 6 percent slopes (Lm; group 2A).—The profile of this mapping unit is the same as that described for uneroded, shallow Lancaster loams. Range site: loamy upland.

Lancaster loam, shallow phase, 2 to 6 percent slopes, eroded (Ln; group 2A).—The profile of this mapping unit differs from that described for the uneroded, shallow Lancaster loams in having lost 3 to 5 inches of the surface layer through erosion. Plowing has mixed some of the finer textured materials of the upper subsoil with the surface soil. Range site: loamy upland.

Lancaster loam, shallow phase, 6 to 12 percent slopes (Lr; group 2B).—The profile of this mapping unit differs from that described as typical for uneroded, shallow Lancaster loams in having a thinner surface layer and a total thickness of about 18 inches. Range site: loamy upland.

LANCASTER FINE SANDY LOAMS

These deep, friable, moderately sandy soils of the uplands occur on the foot slopes of hills and ridges, principally in the western and northern parts of the county. They have developed in noncalcareous, sandy loam or light sandy clay loam parent materials. These materials have weathered from Dakota sandstones and sandy shales and are generally more than 5 feet thick.

Profile description for uneroded Lancaster fine sandy loams:

0 to 10 inches, grayish-brown (10YR 4/2, dry) to dark grayish-brown (10YR 3/2, moist) fine sandy loam; soft when dry, very friable when moist; moderate crumb structure; moderately to slightly acid.

10 to 24 inches, yellowish-brown (10YR 5/4, dry) or dark yellowish-brown (10YR 4/4, moist) fine sandy clay loam or heavy fine sandy loam; hard when dry, very friable when moist; weak coarse prismatic structure that breaks to moderate medium subangular blocks; moderately to slightly acid.

24 to 32 inches, yellowish-red (10YR 5/4, dry) or dark yellowish-brown (10YR 4/4, moist) sandy clay loam; hard when dry, friable when moist; moderate medium prismatic structure that breaks to moderate medium-sized subangular blocky fragments; slightly acid.

32 to 44 inches, yellowish-brown (10YR 5/4, dry) or dark yellowish-brown (10YR 4/4, moist) heavy sandy loam; hard when dry, very friable when moist; weak coarse subangular blocky structure; neutral to slightly acid; contains scattered fragments of ironstone.

44 to 52 inches, light yellowish-brown (10YR 6/4, dry) or yellowish-brown (10YR 5/4, moist) sandy loam; slightly hard to hard when dry, very friable when moist; massive; approximately neutral in reaction.

Lancaster fine sandy loams are well drained to somewhat excessively drained. Surface runoff is very slow, but water penetrates the soils very readily. Permeability is rapid and underdrainage is free. Ground water moves laterally above the underlying bedrock strata and appears at lower levels as seeps and springs. Because they are sandy, these soils have only moderate water-storing capacities and are often droughty late in summer.

Lancaster fine sandy loams are moderately productive. They are best suited to drought-resistant crops that are tolerant of moderate soil acidity. Lime must be added to obtain good stands of legumes. The soils are deficient in phosphorus and, in severely eroded or badly depleted areas, are also low in nitrogen. Tilth is good; both surface soils and subsoils are friable and contain enough sand to make tillage possible through a wide range of moisture content. All of the Lancaster fine sandy loam soils are very susceptible to wind and water erosion.

Lancaster fine sandy loam, 2 to 6 percent slopes (La; group 3A).—The profile of this mapping unit is the same as that described for uneroded Lancaster fine sandy loams. Range site: sandy land.

Lancaster fine sandy loam, 2 to 6 percent slopes, eroded (Lb; group 3A).—This soil differs from that described for uneroded Lancaster fine sandy loams in having lost 4 to 6 inches of the surface layer through erosion. Range site: sandy land.

Lancaster fine sandy loam, 2 to 6 percent slopes, severely eroded (Lc; group 3C).—The profile of this mapping unit differs from that described for uneroded Lancaster fine sandy loams in having lost 6 inches or more of surface soil. Some of the finer textured upper subsoil material is included in the plow layer. Almost all of the soil is gullied. Range site: sandy land.

Lancaster fine sandy loam, 6 to 12 percent slopes (Lf; group 3B).—This soil differs from uneroded Lancaster fine sandy loams on 2 to 6 percent slopes in having a somewhat thinner and lighter colored surface soil. The combined depth of the soil layers is also somewhat less than that indicated as typical for uneroded Lancaster fine sandy loams. Range site: sandy land.

LANCASTER FINE SANDY LOAMS, SHALLOW

These moderately deep, friable, moderately sandy soils of the uplands occur on the crests of hills and ridges, mainly in the northern and western parts of the county. The noncalcareous, moderately sandy parent materials weathered from soft sand-

stone and sandy clay shales of the Dakota formation. These beds are at depths of 22 to 24 inches. In a few areas, the upper few inches of the parent materials have been modified by loess material.

Profile description for uneroded, shallow Lancaster fine sandy loams:

0 to 6 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 3/2, moist) fine sandy loam; soft when dry, very friable when moist; weak to moderate fine granular structure; moderately acid.

6 to 17 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/3, moist) loam; hard when dry, very friable when moist; moderate to weak coarse granular structure; moderately to slightly acid.

17 to 24 inches, reddish-yellow (7.5YR 6/6, dry) or strong-brown (7.5YR 5/6, moist) fine sandy loam; slightly hard to hard when dry, very friable when moist; weak coarse subangular blocky structure; slightly acid to neutral in reaction; contains a few fragments of sandstone.

24 inches +, partially weathered soft sandstone and sandy clay shale of Cretaceous age.

Shallow Lancaster fine sandy loams are somewhat excessively drained. In most areas, surface runoff is slow. Permeability is rapid, and rainfall penetrates the soil readily. The depth of the penetration is limited by the underlying bedrock, as water moves laterally over the surface of the rock. Seeps and springs occur at lower levels where the bedrock strata are exposed. Movement of the ground water is sufficient to prevent high water tables in these soils. Because these soils are shallow and sandy, they have moderately low water-storing capacities and are often droughty late in summer.

Shallow Lancaster fine sandy loams have very low productivity. They are best used as grassland, but shallow-rooted, drought-resistant crops tolerant of moderately acid soils can be grown. To obtain good stands, lime should be added before seeding legumes. The soils are low in available phosphorus and, in severely eroded areas, are low in available nitrogen. They have good tilth but are very susceptible to wind erosion and moderately susceptible to water erosion.

Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes (Ld; group 2A).—The profile of this mapping unit is the same as that described for uneroded, shallow Lancaster fine sandy loams. Range site: sandy land.

Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes, eroded (Le; group 2A).—This soil has lost 3 to 4 inches of the surface layer described as part of the typical profile for uneroded, shallow Lancaster fine sandy loams. The soil is less fertile, contains less organic matter, and is more susceptible to erosion than the uneroded, shallow Lancaster fine sandy loams. Range site: sandy land.

Lancaster fine sandy loam, shallow phase, 6 to 12 percent slopes (Lg; group 2B).—This mapping unit has a surface layer that generally is thinner and somewhat lighter colored than the surface layer described as typical for uneroded, shallow Lancaster fine sandy loams. The combined thickness of surface soil and subsoil usually is less than 18 inches. Range site: sandy land.

LANGLEY SILT LOAMS

These deep, friable, medium-textured soils occur mainly on the old terrace levels of Mulberry, Spring, Dry, and Gypsum Creeks. The soils have the steepest slopes along drainage channels. The friable, silty clay loam parent materials are a mixture of stream alluvium and wind-laid silt (or loess). They are older in age than the alluvial materials on the lower terraces and flood plains and generally have average depths of more than 5 feet. The soils have strong brown and yellow mottles and in some areas have thin strata of very fine sandy loam texture. The mottling appears to be a relic mottling; it is not associated with the present drainage in the area.

Profile description for Langley silt loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb or granular structure; slightly acid.

6 to 12 inches, dark-gray (10YR 4/1, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

12 to 23 inches, dark-gray (10YR 4/1, dry) or very dark grayish-brown (10YR 3/2, moist) heavy silty clay loam; hard when dry, firm when moist; moderate fine subangular blocky structure; nearly neutral in reaction.

23 to 36 inches, dark grayish-brown (10YR 4.5/2, dry) or very dark grayish-brown (10YR 3.5/2, moist) silty clay loam; hard when dry, firm when moist; weak fine and very fine subangular blocky structure; faintly mottled with yellowish brown (10YR 5/6); nearly neutral in reaction.

36 to 60 inches +, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (2.5Y 4/2, moist) silty clay loam; hard when dry, friable when moist; massive to weak coarse subangular blocky structure; slightly alkaline; mottled with brown and yellowish-red spots and streaks.

Langley silt loams are moderately well drained. In most areas surface runoff is slow, but ponding generally does not occur. During periods of normal rainfall, most water penetrates the soils. Permeability is moderately slow, but underdrainage is free. High water tables generally do not occur. The soils have a large water-storing capacity. Most of the water stored in the soil is available to plants.

Langley silt loams are productive and suited to most crops grown in the area. They do not appear to be deficient in nutrient elements. The surface soils and subsoils are friable and can be tilled throughout a moderate range of moisture content. The soils are moderately susceptible to wind erosion. Although the terrace areas on which these soils occur are relatively free of damage by water erosion, they occasionally are subjected to stream overflow. In most areas Langley silt loams show some degree of alkalinity and are associated with Solonetz soils, or salt spots. Where the salt spots are so numerous that they interfere with crop production, the associated soils have been mapped as Langley silt loam-Solonetz complex.

Langley silt loam, 0 to 2 percent slopes (Ls; group 18A).—The profile of this mapping unit is the same as that described for Langley silt loams. Range site: lowland.

Langley silt loam, 2 to 6 percent slopes (Lt; group 18B).—This soil has the same profile characteristics as those described for Langley silt loams, but it usually occurs in long, narrow, irregular-shaped areas along shallow drainageways. Range site: lowland.

LANGLEY SILTY CLAY LOAM

This deep, moderately dark colored soil of the terraces has developed on 2 to 6 percent slopes. It is in areas that were occupied by Langley silt loams before erosion caused the loss of the silt loam surface layer.

The soil usually occurs on the terrace faces. The parent material and drainage are the same as those described for Langley silt loams. Because this soil occupies the steeper parts of slopes and has a finer textured surface layer than the Langley silt loams, water penetrates the surface soil more slowly. Nevertheless, this soil has a large water-storing capacity, and most of the water stored is available to plants.

Profile description of eroded Langley silty clay loam soil:

0 to 5 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; slightly hard when dry, friable when moist; moderate medium and fine granular structure; medium to slightly acid.

5 to 19 inches, dark-gray (10YR 4/1.5, dry) or very dark gray (10YR 3/1.5, moist) heavy silty clay loam; very hard when dry, friable when moist; weak medium prismatic structure that breaks to moderate medium blocky fragments; medium to slightly acid.

19 to 29 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) heavy silty clay loam; hard when dry, friable when moist; weak fine and very fine subangular blocky structure; slightly acid; faintly mottled with yellowish brown.

29 to 35 inches, strongly mottled gray and brown (10YR 5/1.5 and 7.5YR 5/2, dry) or reddish-brown (5YR 4/4 and 5/5, moist) silty clay loam; hard when dry, friable when moist; massive; slightly acid; contains small black concretions, presumably of iron and manganese oxides.

35 to 60 inches, light-gray (2.5Y 7/2, dry) to grayish-brown (2.5Y 5/2, moist) light silty clay; hard when dry, friable when moist; massive; noncalcareous to mildly calcareous in places.

Langley silty clay loam is less productive than the Langley silt loams because much of the fertile surface layer and organic matter have been lost through erosion. Tilth also is less favorable because the finer textured surface soil cannot be tilled within so wide a range of moisture content. The soil is particularly susceptible to water erosion. Because this soil generally occurs as narrow, elongated areas on the terrace breaks or on the sides of small drainageways, it is often difficult to manage as a separate unit. The soil is best used for permanent grass, which will provide pasture or a stable way of access to adjacent more nearly level soils.

Langley silty clay loam, 2 to 6 percent slopes, eroded (Lu; group 18B).—This is the only Langley silty clay loam soil mapped in the county. Its profile characteristics are those described for eroded Langley silty clay loams. Range site: lowland.

LANGLEY SILT LOAM-SOLONETZ COMPLEX

This soil complex occurs mainly on the terraces of Mulberry, Spring, and Dry Creeks in the central and western parts of the county. In these areas, Solonetz soils, or salt spots, are interspersed with normal Langley silt loams. The salt spots occupy at least one-third of the surface and in some areas nearly the entire surface. The salts are toxic to plants, and the spots affected are easily identified by the absence or poor stands of crops and grasses. The surface layers of the salt spots restrict infiltration of water and growth of plant roots. Since the spots are slightly concave, runoff and rain water collect in them and remain until evaporated.

Profile description for Solonetz soil (Langley silt loam-Solonetz complex):

0 to 3 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; very friable when moist; weak fine platy structure; nearly neutral in reaction.

3 to 15 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) clay; extremely hard when dry, extremely plastic when wet; strong fine and medium blocky structure; strongly alkaline.

15 to 36 inches, grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 3/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; strong medium subangular blocky structure; strongly alkaline; contains much accumulated salt.

36 to 60 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) silty clay loam; hard when dry, friable when moist; massive; strongly alkaline; contains much accumulated salt and is mottled with strong-brown or reddish-brown spots and stains.

In areas where this soil complex occurs, surface runoff is very slow and internal drainage is extremely slow. Underdrainage is very poor. Consequently, high water tables frequently develop during periods of heavy rainfall. Because the salt spots are unproductive or support only grasses of low palatability to livestock, the degree of use and the value of this complex depend much upon the frequency of occurrence and toxicity of the salt spots.

Langley silt loam-Solonetz complex, 0 to 2 percent slopes (Lv; group 23).—The profile description of the Solonetz component is described above; that of Langley silt loams (uneroded is described on page 62. Range site: lowland.

LANHAM SILT LOAMS

These shallow, brown, friable soils of the uplands occur on the crests and shoulders of hills and ridges in the extreme western part of the county. The soils generally are less than 20 inches in thickness. They have weathered from the underlying, strongly mottled, noncalcareous, kaolinitic, Terra Cotta clay shales.

Profile description for uneroded Lanham silt loams:

0 to 5 inches, brown (7.5YR 4/2, dry) to dark-brown (7.5YR 3/2, moist) silt loam; soft when dry, very friable when moist; moderate fine crumb structure; slightly acid.

5 to 12 inches, reddish-brown (5YR 5/3, dry) or (5YR 4/3, moist) heavy silt loam or light silty clay loam; hard when dry, friable when moist; moderate coarse granular structure; slightly acid.

12 to 20 inches, reddish-brown (2.5YR 5/4, dry) or (2.5YR 4/4, moist) silty clay; extremely hard when dry, slightly plastic to plastic when wet; moderately developed medium subangular blocky structure; nearly neutral in reaction.

20 inches +, mottled weak-red, reddish-brown, and light-gray massive Terra Cotta clay shales of the Dakota formation.

Lanham silt loams are well drained. In most areas surface runoff is rapid and much of the water falling on the soil is lost. Permeability is slow, and underdrainage is restricted by the underlying shales. Ground water moves laterally above the shale beds and appears at lower levels as seeps and springs. These soils have a low water-storing capacity and are frequently droughty late in summer.

Lanham silt loams are unproductive when tilled and are very susceptible to water erosion. They are best used as permanent pasture.

Lanham silt loam, 2 to 6 percent slopes (Lw; group 2A).—The profile of this mapping unit is the same as that described for uneroded Lanham silt loams. Range site: clay upland.

Lanham silt loam, 2 to 6 percent slopes, severely eroded (Lx; group 2B).—The profile of this mapping unit differs from that described for uneroded Lanham silt loams in having lost most of the surface layer and, in some places, part of the upper subsoil through erosion. It is less fertile, contains less organic matter, and is more susceptible to erosion than uneroded Lanham silt loams. Gullying is nearly always present. Range site: clay upland.

Lanham silt loam, 6 to 12 percent slopes (Ly; group 2B).—This soil differs from that described as typical for uneroded Lanham silt loams in having a thinner surface layer and, in most areas, a total depth to bedrock of less than 15 inches. Range site: clay upland.

LINCOLN LOAMY FINE SANDS

These deep, light-colored soils of the bottom lands are developing on calcareous, sandy, alluvial parent materials that have been partially reworked by wind. The alluvial materials are generally more than 5 feet thick. Where the materials have been strongly reworked by wind, their texture is relatively uniform, but well-sorted strata are present nearly everywhere below depths of 3 or 4 feet. These soils have their greatest extent on the undulating to rolling flood plains of the Smoky Hill River, chiefly in the southern part of the county. In some of these areas they occur on dunelike relief.

Profile description for Lincoln loamy fine sands:

0 to 16 inches, gray (10YR 5/1, dry) to dark-gray (10YR 4/1, moist) loamy fine sand; soft when dry, very friable when moist; calcareous; weak very fine granular to single grain structure.

16 to 24 inches, light-gray (10YR 7/2, dry) to pale-brown (10YR 6/3, moist) loamy fine sand; soft when dry, very friable when moist; massive to single grained; calcareous.

24 to 72 inches, white (10YR 8/2, dry) to yellowish-brown (10YR 5/4, moist) loamy fine sand; loose when dry, very friable when moist; massive to single grained; calcareous.

Lincoln loamy fine sands are excessively drained. Permeability is very rapid and underdrainage is free. Consequently, most of the water falling on these soils is absorbed. There is very little surface runoff. The soils have a low water-storing capacity and are usually droughty late in summer and during other periods when rainfall is below normal.

Lincoln loamy fine sands have good tilth and are easily tilled throughout a wide range of moisture content. Their unstable structure, however, makes them very susceptible to wind erosion. They are droughty, low in organic matter, and somewhat deficient in phosphorus and nitrogen. These soils are best used for sorghum or pasture.

Lincoln loamy fine sand, 0 to 2 percent slopes (Lz; group 22A).—The profile of this mapping unit is the same as that described for Lincoln loamy fine sands. Range site: sandy land.

Lincoln loamy fine sand, 2 to 6 percent slopes (Lza; group 22A).—The profile of this mapping unit is the same as that described for Lincoln loamy fine sands. Since this soil occurs on steeper slopes, its management is more difficult than that of Lincoln loamy fine sand, 0 to 2 percent slopes. Range site: sandy land.

LINDSBORG SILT LOAM

This deep, friable, soil of the uplands has developed on calcareous, silty loess deposits, mainly in the south-central part of the county. The parent materials are usually more than 5 feet thick, and they overlie brown to reddish-brown loess materials of Loveland age. Since the soil generally occupies shallow depressions, it is frequently ponded during periods of heavy rainfall.

Profile description of Lindsborg silt loam:

0 to 10 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) silt loam; slightly hard when dry, very friable when moist; weakly developed fine crumb structure; moderately acid.

10 to 12 inches, light-gray (10YR 7/1, dry) or light brownish-gray (10YR 6/2, moist) silt loam; soft when dry, very friable when moist; weak to moderate fine platy structure; slightly acid.

12 to 28 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; strong medium blocky structure; nearly neutral in reaction.

28 to 48 inches, gray (10YR 6/1, dry) or (10YR 5/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; weakly calcareous; frequently contains a few nodules of calcium carbonate.

Lindsborg silt loam is poorly drained and imperfectly oxidized. In most areas, surface runoff is restricted and ponding occurs. Permeability is very slow, and underdrainage is restricted. The water table fluctuates but usually is fairly near the surface.

Lindsborg silt loam soil has poor tilth. It is hard to work and very susceptible to wind erosion. Because it is often ponded, it is suited only to crops that can withstand a wet and poorly aerated soil.

Lindsborg silt loam, 0 to 2 percent slopes (Lzb; group 17A).—This is the only phase of Lindsborg silt loam mapped in the county. Its profile is the one described for Lindsborg silt loam. Range site: lowland.

LOCKHARD SILT LOAMS

These deep, friable, dark-colored soils occur principally on upland flats in the south-central part of the county. They are developing in wind-deposited materials that have been altered by prolonged periods of ponding or marshlike conditions. In most areas the parent materials are more than 5 feet thick. As depth increases these materials are gradually replaced by materials similar to those that underlie Langley soils; that is, by reddish loess deposits of older age. The ponded or marshlike conditions that prevailed either during the deposition of the parent materials, or immediately following, are believed to have been caused from back waters during the youthful stages of the Smoky Hill and Saline River Valleys. The gray colors observed in the soil profile reflect the relic drainage characteristics rather than present drainage conditions.

Profile description for uneroded Lockhard silt loams:

0 to 5 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb or granular structure; moderately acid.

5 to 16 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) light silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; moderately acid.

16 to 26 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate to strong medium blocky structure; slightly acid.

26 to 30 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium blocky structure; slightly alkaline.

30 to 38 inches, light brownish-gray (2.5Y 6/2, dry) or grayish-brown (2.5Y 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weakly developed coarse subangular blocky structure; calcareous; contains concretions of accumulated calcium carbonate.

38 to 60 inches, light-gray (5Y 7/2, dry) or light olive-gray (5Y 6/2, moist) light silty clay; extremely hard when dry, extremely plastic when wet; massive; calcareous.

Lockhard silt loams are well drained. In most areas, surface runoff is moderately slow and permits water to enter the soils. Permeability is moderate, and underdrainage is free. Water tables generally do not develop. The soils have a large water-storing capacity, but the water stored in the fine-textured subsoils is only slowly available to plants.

Lockhard silt loams have fair tilth. They are friable, easily tilled, and moderately resistant to erosion. Their heavy claypan subsoils retard the movement of water and the development of plant roots. As a result the soils may be temporarily waterlogged following heavy rains or they may be droughty late in summer. The soils are best used for small grains or pasture.

In a few areas, these soils have browner subsoils, are slightly more friable, and contain less accumulated lime than the typical profile described for uneroded Lockhard silt loams.

Lockhard silt loam, 0 to 2 percent slopes (Lza; group 7A).—The profile of this mapping unit is the same as that described for uneroded Lockhard silt loams. Range site: lowland.

Lockhard silt loam, 0 to 2 percent slopes, eroded (Lze; group 7A).—This soil differs from the uneroded phase in having lost 2 to 3 inches of the surface layer as described for the typical profile. Plowing has mixed some of the finer textured upper subsoil into the surface soil. Range site: lowland.

Lockhard silt loam, 2 to 6 percent slopes (Lzf; group 7B).—This soil has a thinner surface layer and a thinner and somewhat less compact subsoil than that described for uneroded Lockhard silt loams. It generally occurs as long, narrow, irregular-shaped bodies along the sides of shallow drainage channels. Range site: lowland.

Lockhard silt loam, 2 to 6 percent slopes, eroded (Lzg; group 7B).—This soil occurs in positions similar to those of the uneroded phase on 2 to 6 percent slopes. It differs from uneroded Lockhard silt loams in having lost 2 to 3 inches of the surface layer and in having had some of the finer textured upper subsoil incorporated in the plow layer. Range site: lowland.

Lockhard silt loam, 2 to 6 percent slopes, severely eroded (Lzh; group 7C).—The profile of this mapping unit differs from that described for uneroded Lockhard silt loams in having lost most of the surface soil and, in places, part of the upper subsoil. The plow layer contains much fine-textured material from the upper subsoil. Gullying usually is present. This soil nearly always occurs on the sloping sides of small drains, where it is difficult to manage and protect from erosion. Range site: lowland.

LOCKHARD LOAMY FINE SAND, OVERBLOWN

This deep, loose, sandy soil occurs near the margins of upland areas that border terraces along Mulberry Creek. It has developed in wind-deposited materials that overlie buried Lockhard silt loams. The average thickness of the overblown sands is about 20 inches. Beneath the overblown material, the material is very similar to that described for the subsoils of Lockhard silt loams.

Profile description of Lockhard loamy fine sand, overblown phase:

0 to 6 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/2, moist) loamy fine sand; loose when dry, very friable when moist; single grains; nearly neutral in reaction.

6 to 13 inches, grayish-brown (10YR 5/2, dry) or very dark grayish-brown (10YR 3/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; nearly neutral in reaction.

13 to 19 inches, dark grayish-brown (10YR 4/2, dry) to very dark brown (10YR 2/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; nearly neutral in reaction.

19 to 26 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to weakly developed coarse blocky structure; nearly neutral in reaction.

26 to 37 inches, light brownish-gray (2.5Y 6/2, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium blocky structure; mildly alkaline in reaction; mottled with yellowish-brown (10YR 6/4, dry).

37 to 58 inches, light-gray (2.5Y 7/2, dry) or light brownish-gray (2.5Y 6/2, moist) silty clay loam; very hard when dry, friable when moist; massive; calcareous; mottled with brownish yellow (10YR 6/6); contains a few concretions of calcium carbonate.

This soil is moderately well drained. Permeability is rapid in the upper part of the profile and slow in the finer textured lower part. Most rainwater enters the soil. Since subsurface drainage is frequently restricted, water tables are often present at depths of 5 feet or less. The soil has a moderate water-storing capacity, but water stored in the lower part of the profile is slowly available to plants.

This soil has fair tilth. The upper layers are friable and easily tilled but are very susceptible to wind erosion. Some areas show evidence of reworking by wind. The buried soils have claypan horizons that restrict root development. The soil is relatively unproductive and is deficient in both available phosphorus and nitrogen. When tilled it is best used for drought-resistant, early maturing crops.

Lockhard loamy fine sand, overblown phase, 2 to 6 percent slopes (Lzc; group 7B).—Only one unit—2 to 6 percent slopes—of this soil is mapped in the county. Its profile is the one described. Range site: sandy land.

LONGFORD SILT LOAMS

These deep, friable soils of the uplands occur on the foot slopes of hills and ridges, principally in the south-central and eastern parts of the county. They are developing in deep, friable, moderately fine textured, windblown deposits of Loveland age. These deposits have been modified by outwash and valley fill weathered from Cretaceous strata in adjacent upland areas. Generally, the parent materials are more than 5 feet thick and overlie bedrock.

Profile description for Longford silt loams:

0 to 9 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 3/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

9 to 16 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

16 to 33 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay; extremely hard when dry, very friable when wet; moderately developed medium blocky structure; nearly neutral in reaction.

33 to 44 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay; extremely hard when dry, very plastic when wet; moderate to weak coarse blocky structure; calcareous; contains concretions of accumulated calcium carbonate.

44 to 60 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains concretions of accumulated calcium carbonate and a few scattered fragments of ironstone and sandstone.

Longford silt loams are well drained. Permeability is moderate and underdrainage is free. Their water-storing capacity is large, but water stored in the lower subsoils is slowly available to plants.

Longford silt loams have fair tilth. They are easily worked over a wide range of moisture content but are only moderately resistant to erosion. Where runoff accumulates, the soils are particularly susceptible to gullying. The soils are somewhat low in available phosphorus, particularly if wheat has been grown

continuously for several years. If eroded, they are deficient in available nitrogen early in spring. The fine-textured subsoils retard free development of roots but do not prevent penetration of roots.

Longford silt loam, 0 to 2 percent slopes (Lzk; group 9A).—The profile of this mapping unit is the same as that described for Longford silt loams. Range site: clay upland.

Longford silt loam, 2 to 6 percent slopes (Lzl; group 9B).—The profile of this soil is the same as that described for Longford silt loams. It is mapped separately because it occupies steeper slopes and requires more careful management. Range site: clay upland.

LONGFORD SILTY CLAY LOAM

This soil has developed in areas where Longford silt loams have been excessively eroded. It differs from Longford silt loams mainly in the finer texture of the surface layer. The parent materials are the same.

Profile description of eroded Longford silty clay loam soil:

0 to 7 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay loam; hard when dry, friable when moist; weak coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

7 to 24 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium blocky structure; nearly neutral in reaction.

24 to 35 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay; extremely hard when dry, very plastic when wet; moderate to weak coarse blocky structure; calcareous; contains concretions of accumulated calcium carbonate.

35 to 60 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains concretions of accumulated calcium carbonate and scattered ironstone and sandstone.

This soil has poorer tilth and a less stable structure than Longford silt loam soils. It does not absorb water readily and is very susceptible to both wind and water erosion. It is deficient in organic matter and in available phosphorus and nitrogen.

Longford silty clay loam, 2 to 6 percent slopes, eroded (Lzm; group 9B).—This is the only phase of Longford silty clay loam mapped in the county. Its profile is that described for eroded Longford silty clay loam. Range site: clay upland.

MADE LAND

Made land, 0 to 2 percent slopes (group 24).—Included in this miscellaneous land type are soils that have been disturbed or covered by cuts and fills and areas that are used for military purposes.

MALMGREN SILT LOAMS

These deep, friable soils of the uplands occur mainly in the southern part of the county. They usually occupy the lower foot slopes or covelike heads of drainage channels. They are developing in calcareous colluvial and alluvial outwash derived from areas of Ninnescah shales and associated soils. The silty clay or clay parent materials usually are more than 6 feet thick and overlie more friable colluvial and alluvial wash or bedrock.

Profile description for Malmgren silt loams:

0 to 6 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate very fine granular structure; nearly neutral in reaction.

6 to 15 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; weak to moderately developed medium granular or very fine subangular blocky structure; nearly neutral in reaction; surfaces of soil aggregates are coated with thin films of light gray that are visible only in dry weather.

15 to 20 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) heavy silty clay loam; very hard when dry, firm when moist; moderate fine subangular blocky structure; nearly neutral in reaction.

20 to 44 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium blocky structure; slightly alkaline.

44 to 52 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) clay; extremely hard when dry, extremely plastic when wet; weak coarse blocky structure; calcareous; contains a few concretions of calcium carbonate.

52 to 84 inches +, brown (10YR 5/3, dry) or yellowish-brown (10YR 5/4, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains concretions of calcium carbonate.

Malmgren silt loams are well drained. In most areas, surface runoff is fairly rapid. Permeability is moderately slow in the upper part of the profile and slow in the lower part. Underdrainage is moderately slow to slow. Water stored in the finer textured subsoils is slowly available to plants.

Malmgren silt loams have fair tilth. They are moderately resistant to wind erosion but are very susceptible to water erosion, particularly gullying. The heavy subsoils retard the development of plant roots and restrict the movement of water. During periods of heavy rainfall the subsoils may be waterlogged. During the dry season these soils shrink and crack and injure roots of plants that are already established in soil.

Malmgren silt loams are moderately productive and best suited to crops that make their major growth in spring and early in summer. They are somewhat deficient in available phosphorus but are adequately supplied with nitrogen when carefully managed.

Malmgren silt loam, 0 to 2 percent slopes (Mb; group 6A).—The profile of this mapping unit is the same as that described for Malmgren silt loams. Range site: clay upland.

Malmgren silt loam, 2 to 6 percent slopes (Mc; group 6A).—This soil differs from Malmgren silt loam, 0 to 2 percent slopes, only in degree of slope and need for more careful management. Range site: clay upland.

MARYDEL SILT LOAM

This deep, friable soil occurs chiefly on the high terraces bordering the Saline River and Mulberry, Spring, and Dry Creeks. It has developed in older alluvial deposits than those present on the flood plains. The deposits are moderately fine textured and silty near the surface but lower in the profile are mottled sandy clay loams that frequently contain lenses of loamy fine sand. The parent materials are usually 4 to 6 feet thick and overlie fine-textured alluvial deposits.

Profile description of Marydel silt loam soil:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; slightly acid.

6 to 19 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; weak to moderate coarse granular or very fine subangular blocky structure; slightly acid.

19 to 25 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate to weak coarse subangular blocky structure; nearly neutral in reaction.

25 to 36 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, friable when moist; massive to very weakly developed coarse subangular blocky structure; nearly neutral in reaction; mottled with strong brown (7.5YR 5/6).

36 to 48 inches, light yellowish-brown (10YR 6/4, dry) or brown (10YR 5/3, moist) sandy clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction; horizon strongly mottled with strong brown (7.5YR 5/6).

48 to 60 inches, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; nearly neutral in reaction.

Marydel silt loam soil is imperfectly drained to well drained. In most areas runoff is slow and the soil may be ponded for short periods. Permeability is moderate, but underdrainage is restricted by the fine-textured alluvial beds. Water tables are nearly always present but their depth usually is sufficient to permit growth of crops.

Marydel silt loam soil has fair tilth. It is easily tilled but is susceptible to wind erosion unless properly managed. The soil is well suited to most crops grown in the county. Deep-rooted crops may not do as well as other crops because the subsoil is poorly drained. Only one unit was mapped in the county.

Marydel silt loam, 0 to 2 percent slopes (Mg; group 20).—The profile of this soil is the same as that described for Marydel silt loam soil. Range site: lowland.

MARYDEL LOAM, POORLY DRAINED VARIANT

This deep, friable soil occurs on the margins of the Saline River terraces. It is developing in mottled, fine sandy clay loam materials that are a mixture of heavy-textured alluvial deposits and wind-worked alluvial sands. These materials rest on silty clay alluvium at depths of 3 to 5 feet.

Profile description of poorly drained Marydel loam:

0 to 12 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; nearly neutral in reaction.

12 to 18 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) fine sandy loam; slightly hard when dry, very friable when moist; very weak fine granular structure; nearly neutral in reaction.

18 to 24 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) fine sandy clay loam; hard when dry, friable when moist; massive to very weak coarse subangular blocky structure; slightly alkaline in reaction; intensely mottled with brownish yellow (10YR 6/6).

24 to 36 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) fine sandy clay loam; hard when dry, friable when moist; massive; calcareous; contains concretions of calcium carbonate and is intensely mottled with brownish yellow.

36 to 66 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; calcareous.

In most areas where this soil occurs, surface runoff is very slow and ponding frequently occurs. Permeability is moderate, but underdrainage is restricted by the fine-textured underlying alluvial beds. High water tables occur often enough to interfere with crops on this soil.

This soil warms slowly in the spring and is often wet during the early part of the growing season. It is not suited to crops that require good drainage and is only moderately productive. Only one unit was mapped in the county.

Marydel loam, poorly drained variant, 0 to 2 percent slopes (Me; group 20).—The profile of this mapping unit is the same as that described for poorly drained Marydel loam. Range site: lowland.

MARYDEL FINE SANDY LOAM

This deep, friable, soil occurs on terraces along the Saline River and along Mulberry and Spring Creeks. It is developing in fine sandy clay loam alluvial materials that overlie heavy plastic clay beds at depths of 3 to 4 feet.

Profile description of Marydel fine sandy loam:

0 to 8 inches, dark-gray (10YR 4/1, dry) or very dark brown (10YR 2/2, moist) fine sandy loam; soft when dry, very friable when moist; weak very fine granular to single grain structure; slightly acid.

8 to 21 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) sandy clay loam; hard when dry, friable when moist; weak coarse subangular blocky structure; slightly acid.

21 to 30 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) fine sandy clay loam; hard when dry, friable when moist; massive to weak coarse subangular blocky structure; nearly neutral in reaction; strongly mottled with strong brown (7.5YR 5/6).

30 to 60 inches, light-gray (2.5Y 7/2, dry) or light brownish-gray (2.5Y 6/2, moist) silty clay; extremely hard when dry and extremely plastic when wet; massive; slightly alkaline in reaction.

Marydel fine sandy loam soil is moderately well drained. Surface runoff is very slow in most areas. Ponding, however, seldom occurs. Permeability is moderate, but underdrainage is restricted by the heavy clay beds which lie beneath the soil. Water tables, when present, are seldom high enough to interfere with growth of crops.

Marydel fine sandy loam is moderately productive. It is often droughty late in the growing season. Because of its poorly drained subsoil, it is not well suited to deep-rooted crops, and crops are sometimes difficult to harvest following heavy rains. Only one unit was mapped in the county.

Marydel fine sandy loam, 0 to 2 percent slopes (Md; group 20).—The profile of this mapping unit is the same as that described for Marydel fine sandy loam. Range site: lowland.

MARYDEL LOAMY FINE SAND

This deep, loose sandy soil occurs on the margins of terraces along the Saline River and along Spring and Mulberry Creeks. It is developing in very sandy alluvial material that has been reworked by the wind and deposited over beds of plastic alluvial clays. Depths to the clay strata range from about 4 to 6 feet.

Profile description of Marydel loamy fine sand:

0 to 5 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1.5, moist) loamy fine sand; loose when dry, very friable when moist; single grain (structureless); slightly acid.

5 to 17 inches, grayish-brown (10 YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; weak coarse granular structure; moderately to slightly acid.

17 to 24 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) sandy clay loam; hard when dry, friable when moist; weak coarse subangular blocky structure; slightly acid.

24 to 35 inches, yellowish-brown (10YR 5/4, dry) or dark yellowish-brown (10YR 4/4, moist) clay loam or sandy clay loam; hard when dry, friable when moist; massive to weak very coarse subangular blocky structure; nearly neutral in reaction.

35 to 48 inches, light yellowish-brown (10YR 6/4, dry) or brown (10YR 4/3, moist) clay loam; hard when dry, very friable when moist; massive; nearly neutral in reaction.

48 to 60 inches, yellowish-red (5YR 4/6, dry) or reddish-brown (5YR 4/4, moist) fine sandy clay; very hard when dry and plastic when wet; massive; nearly neutral in reaction.

Marydel loamy fine sand is moderately well drained. In most areas, runoff is very slow, but permeability is moderate and water falling on the soil is readily absorbed. Underdrainage is restricted by the fine-textured alluvial beds. Water tables, which are present following heavy rains, usually are deep enough to permit the growth of most crops. The soil has a low water-storing capacity and is frequently droughty late in summer.

Marydel loamy fine sand is relatively unproductive. Although easily tilled, the soil is droughty, susceptible to wind erosion, and low in available phosphorus. It is best suited to drought-resistant row crops, but careful management is required to prevent wind erosion when open-tilled crops are grown. Only one unit is mapped in the county.

Marydel loamy fine sand, 0 to 2 percent slopes (Mf; group 20).—The profile of this mapping unit is the same as that described for Marydel loamy fine sand. Range site: sandy land.

McPHERSON SILT LOAM

This deep, friable soil occupies broad flats or covelike heads of drainageways, principally in upland areas bordering stream valleys in the central and southern parts of the county. It is developing in fine-textured, calcareous wind deposits that appear to have been subjected to ponding or to marshlike conditions. In most areas these materials are 5 to 6 feet thick, or more, and they often overlie mottled materials similar to those underlying Langley soils.

Profile description of McPherson silt loam:

0 to 10 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderately well developed medium granular structure; slightly acid.

10 to 18 inches, gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderately developed coarse granular structure; slightly acid; surfaces of soil aggregates have a coating of light gray (10YR 7/2) that is visible only when dry.

18 to 22 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate fine and medium blocky structure; nearly neutral in reaction.

22 to 36 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium and coarse blocky structure; nearly neutral in reaction.

36 to 54 inches, grayish-brown (2.5Y 3/2, dry) or dark grayish-brown (2.5Y 4/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; weak to moderate coarse blocky structure; calcareous; contains concretions of calcium carbonate.

54 to 66 inches, light brownish-gray (2.5Y 6/2, dry) or grayish-brown (2.5Y 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; calcareous.

McPherson silt loam is moderately well drained. Runoff usually is very slow, and some areas may be ponded following heavy rains. Permeability is slow when the soil is moist. Underdrainage is free; high water tables seldom develop. The water-storing capacity of the soil is large, but moisture stored in the fine-textured subsoil is slowly available to plants.

McPherson silt loam is moderately productive. It is best suited to crops that do not require large amounts of soil moisture late in summer. Its heavy claypan subsoil restricts, and at times prevents, root development. During dry periods, shrinking and cracking in the claypan layer may seriously damage deep-growing roots. Available phosphorus and nitrogen are sufficient for most crops, except where the soil has been seriously eroded or used in successive years for wheat crops. The soil has fair tilth, is easily tilled throughout a wide range of moisture content, and is not subject to serious erosion if properly managed. Only one unit is mapped in the county.

McPherson silt loam, 0 to 3 percent slopes (Ma; group 8A).—The profile of this mapping unit is the one described for McPherson silt loam. Range site: clay upland.

MUIR SILT LOAMS

These deep, friable soils are most extensive on the terraces along Gypsum, Spring, and Mulberry Creeks. They have developed in noncalcareous, silty, alluvial materials that are somewhat older than the alluvium of the present flood plains. The parent materials usually are more than 5 feet thick and overlie other alluvial deposits.

Profile description for Muir silt loams:

0 to 14 inches, grayish-brown (10YR 5/2, dry) or very dark brown (10YR 2/2; moist) silt loam; slightly hard when dry, very friable when moist; moderate fine granular or fine crumb structure; nearly neutral in reaction.

14 to 26 inches, very dark gray (10YR 3/1, dry) or very dark brown (10YR 2/2, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular structure; nearly neutral in reaction.

26 to 34 inches, grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderately well developed medium subangular blocky structure that breaks to moderate coarse granular structure; nearly neutral in reaction.

34 to 50 inches, yellowish-brown (10YR 5/4, dry) or brown (10YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

Muir silt loams are well drained. Surface runoff is slow, but permeability is moderate to moderately rapid and underdrainage is free. Ponding generally does not occur. The soils have a large water-storing capacity, and most of the water stored is available to plants.

Muir silt loams are very productive and are suited to all crops grown in the county. They have good tilth, are not noticeably deficient in plant nutrients, and are resistant to erosion if properly managed.

Muir silt loam, 0 to 2 percent slopes (Mh; group 18A).—The profile of this mapping unit is the same as that described for Muir silt loams. Range site: lowland.

Muir silt loam, 2 to 6 percent slopes (Mk; group 18B).—The profile of this mapping unit is the same as that described for Muir silt loams. The soil differs from that on 0 to 2 percent slopes mainly in occurring on steeper slopes. It is in long, narrow, irregularly shaped areas that are more difficult to manage as separate units than are areas of the phase on slopes of 0 to 2 percent. Range site: lowland.

NEW CAMBRIA SILTY CLAY LOAM

This soil occurs on the low terraces along the Smoky Hill River. It is developing in calcareous, fine-textured alluvial materials. These materials have an average thickness of about 5 feet and usually overlie more friable, medium-textured alluvial deposits.

Profile description of New Cambria silty clay loam:

0 to 5 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) silty clay loam; slightly hard when dry, very friable when moist; strong very fine granular structure; calcareous.

5 to 23 inches, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (2.5Y 4/2, moist) silty clay; hard when dry, very friable when moist; strong coarse granular or very fine subangular blocky structure; calcareous.

23 to 37 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; hard when dry, friable when moist; moderate very coarse granular or fine subangular blocky structure; calcareous.

37 to 52 inches, pale-brown (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) silty clay; very hard when dry, friable when moist; weak to moderate fine subangular blocky structure; calcareous; contains concretions of calcium carbonate.

New Cambria silt loam is a well-drained soil. Surface runoff is very slow but permeability is moderately rapid and underdrainage is free. Ponding seldom occurs, and high water tables seldom are present. Although the water-storing capacity of the soil is large, moisture stored in the fine-textured subsoil is only slowly available to plants.

New Cambria silty clay loam is a very productive soil and suited to all crops grown in the area. It is not deficient in plant nutrients, unless it has been seriously eroded or depleted through continuous cropping. Tilth is fair, and tillage by conventional machinery is possible throughout a fair range of soil moisture conditions. The soil puddles easily if plowed when wet. Harvesting also is difficult when the soil is wet. The use of heavy machinery on the wet soil causes compaction. Only one unit was mapped in the county.

New Cambria silty clay loam, 0 to 2 percent slopes (Na; group 14A).—The profile of this mapping unit is that described for New Cambria silty clay loam. Range site: lowland.

NILES SILT LOAMS

These deep, friable soils of the uplands occur principally in the southeastern part of the county. They have developed in medium textured to moderately fine textured, calcareous, loess deposits. The deposits average about 5 feet in thickness and usually overlie older Loveland loess or sandstone, limestone, or shale bedrocks.

Profile description for uneroded Niles silt loams:

0 to 8 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; moderately acid.

8 to 13 inches, light grayish-brown (10YR 6/2, dry) or dark-gray (10YR 4/1, moist) silty clay loam; hard when dry, friable when moist; moderate very coarse granular structure; moderately acid; surfaces of soil aggregates are coated with a film of light gray (10YR 7/2) that is visible only when the soil is dry.

13 to 32 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry and extremely plastic when wet; moderate fine and medium blocky structure; moderately acid.

32 to 37 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay loam; hard when dry, friable when moist; weak coarse blocky structure; calcareous; contains concretions of calcium carbonate.

37 to 48 inches, light-gray (2.5Y 7/2, dry) or light brownish-gray (2.5Y 6/2, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous.

Niles silt loams are well drained. Surface runoff is moderately slow, but permeability is moderate and underdrainage is free. Ponding seldom occurs. The water-storing capacity of the soils is large, but moisture stored in their fine-textured subsoils is slowly available to plants.

Niles silt loams are productive soils. Because they are droughty and have a heavy claypan subsoil, they are best suited to shallow-rooted crops that do not require large amounts of moisture late in summer. Good stands of alfalfa are obtained, but yields decrease substantially on second cuttings. The soils have fair tilth, are easily tilled within a moderate range of moisture content, and are resistant to erosion if properly managed. They are low in

available phosphorus but are not deficient in available nitrogen unless they have been seriously depleted by continuous cropping.

Niles silt loam, 0 to 2 percent slopes (Nb; group 8A).—The profile of this mapping unit is the same as that described for uneroded Niles silt loams. Range site: clay upland.

Niles silt loam, 2 to 6 percent slopes (Nc; group 8B).—The profile of this mapping unit differs from that described for uneroded Niles silt loams in having a somewhat thinner surface soil. Range site: clay upland.

Niles silt loam, 2 to 6 percent slopes, severely eroded (Ng; group 8C).—Except for degree of erosion, the profile of this soil is like that described for uneroded Niles silt loams. Range site: clay upland.

NILES SILTY CLAY LOAMS

These deep soils have developed from the same kind of parent material as the Niles silt loams. They occur in the same areas as the Niles silt loams but differ from them in having lost the silt loam surface layer through erosion. The plow layer of these soils consists of silty clay loam.

Profile description for eroded Niles silty clay loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay loam; hard when dry, friable when moist; moderate to weak coarse granular structure; moderately acid.

6 to 10 inches, light grayish-brown (10YR 6/2, dry) or dark-gray (10YR 4/1, moist) silty clay loam; hard when dry, friable when moist; weak coarse granular structure; moderately acid; the soil particles in this horizon frequently are coated with a thin film of light gray (10YR 7/2) that is visible only when the soil is dry.

10 to 28 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate fine and medium blocky structure; slightly acid.

28 to 33 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium and coarse subangular blocky structure; calcareous, contains a few small concretions of accumulated calcium carbonate.

33 to 60 inches, light-gray (2.5Y 7/2, dry) or light brownish-gray (2.5Y 6/2, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous.

Niles silty clay loams have approximately the same drainage as Niles silt loams. Because of their finer texture, they have less favorable tilth and cannot be tilled within so wide a range of moisture content. They are very susceptible to continued erosion by wind and water.

Niles silty clay loams are less productive than Niles silt loams. Their natural fertility is lower, and they contain less organic matter. They are deficient in available phosphorus, and occasionally the supply of available nitrogen is too low to permit optimum yields.

Niles silty clay loam, 0 to 2 percent slopes, eroded (Na; group 8A).—The profile of this mapping unit is the same as that described for eroded Niles silty clay loams. Range site: clay upland.

Niles silty clay loam, 2 to 6 percent slopes, eroded (Ne; group 8B).—The profile of this mapping unit is the same as that described for eroded Niles silty clay loams. This unit occurs on steeper slopes and requires more careful management than Niles silty clay loam, 0 to 2 percent slopes, eroded. Range site: clay upland.

Niles silty clay loam, 2 to 6 percent slopes, severely eroded (Nf; group 8C).—The profile of this mapping unit differs from that described for eroded Niles silty clay loams in having lost nearly all of the surface layer and, in some places, part of the upper subsoil. Range site: clay upland.

NINNESCAH SILT LOAMS

These deep, friable soils of the uplands occur almost entirely in the southern part of the county. They have developed in calcareous, moderately fine textured, colluvial and alluvial outwash that weathered from red clay shales and limestone. These parent materials occupy the lower foot slopes, are usually more than 5 feet thick, and overlie shale bedrock.

Profile description for Ninnescah silt loams:

0 to 6 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb structure; moderately acid.

6 to 11 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) heavy silt loam; hard when dry, friable when moist; moderate coarse granular structure; nearly neutral in reaction.

11 to 24 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; weak to moderate medium prismatic structure that breaks to moderate medium subangular blocks; nearly neutral in reaction.

24 to 36 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) silty clay loam; hard when dry, friable when moist; weak coarse subangular blocky structure; nearly neutral in reaction.

36 to 44 inches, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains concretions of calcium carbonate.

44 to 66 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous; contains some nodules of calcium carbonate and many fragments of partially decayed shale.

Ninnescah silt loams are well drained. Surface runoff is moderate. Permeability is moderately rapid and underdrainage is free. The water-storing capacity of these soils is large, and most of the water stored is available to plants.

Ninnescah silt loams have fair tilth. They are easily tilled throughout a fairly wide range of moisture content, but they are moderately susceptible to erosion, particularly gully erosion.

Ninnescah silt loams are moderately productive and suited to most crops grown in the county. They are low in available phosphorus, and in many areas, particularly those areas where wheat has been grown in successive years, they are deficient in nitrogen.

Ninnescah silt loam, 0 to 2 percent slopes (Nh; group 10A).—This soil differs from that described for Ninnescah silt loams in having somewhat thicker and darker colored surface soil and subsoil. The subsoil also is slightly finer textured. Range site: loamy upland.

Ninnescah silt loam, 2 to 6 percent slopes (Nk; group 10B).—The profile of this mapping unit is the same as that described for Ninnescah silt loams. Range site: loamy upland.

PRATT FINE SANDY LOAMS

These deep, friable soils occur on the margins of stream terraces and in upland areas adjacent to the stream valleys. The deep, sandy parent materials were picked up by the wind in sandy alluvial areas and deposited on the adjacent upland or as low dunes on the margins of the terraces. The parent materials average more than 6 feet in thickness and usually overlie alluvial deposits or, on the uplands, buried soils that were developed before the windborne materials were deposited.

Profile description for uneroded Pratt fine sandy loams:

0 to 7 inches, dark grayish-brown (10YR 4/2, dry) or very dark gray (10YR 4/1, moist) fine sandy loam; soft when dry, very friable when moist; weak very fine granular structure; moderately acid.

7 to 16 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; weak coarse granular structure; moderately acid.

16 to 29 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/3, moist) fine sandy clay loam; hard when dry, friable when moist; weak coarse prismatic structure that breaks to moderate subangular blocks; slightly acid.

29 to 42 inches, brown (7.5YR 5/2, dry) or (7.5YR 4/2, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive; nearly neutral in reaction.

42 to 60 inches, light-brown (7.5YR 6/4, dry) or brown (7.5YR 5/4, moist) loamy fine sand; loose when dry, very friable when moist; single grained; nearly neutral in reaction.

Pratt fine sandy loams are well drained. Surface runoff is slow, but permeability is moderately rapid to rapid and underdrainage is free. Most of the rainfall penetrates these soils. Because they are sandy, these soils have a low water-storing capacity and are droughty late in summer.

Pratt fine sandy loams have good tilth and are easily tilled throughout a wide range of moisture content. If tilled too much, they are subject to excessive wind erosion. The soils are relatively unproductive; they are best suited to drought-resistant crops that make most of their growth early in the growing season.

Pratt fine sandy loam, 2 to 6 percent slopes (Pa; group 12).—The profile of this mapping unit is the same as that described for uneroded Pratt fine sandy loams. Range site: sandy land.

Pratt fine sandy loam, 2 to 6 percent slopes, eroded (Pb; group 12).—This soil differs from the uneroded phase on slopes of 2 to 6 percent in having lost 4 to 5 inches of the surface layer, largely through wind erosion. This type of erosion has left the surface hummocky in most areas. Range site: sandy land.

RENTIDE SILT LOAM

This deep, friable, reddish-colored soil occurs mainly on the uplands in the southern part of the county. It occupies the undulating to moderately steep upper foot slopes of hills and ridges. The fine-textured, calcareous parent materials have weathered

from the underlying red shales. In some areas the upper few inches of the surface layer has been modified by loess deposits. The parent material is generally about 4 feet deep to the weathered or partially weathered red shales.

Profile description of Rentide silt loam:

0 to 4 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate crumb structure; slightly acid.

4 to 13 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular structure; nearly neutral in reaction.

13 to 27 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderately well developed medium blocky structure; nearly neutral in reaction.

27 to 40 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weak coarse subangular blocky structure; calcareous; contains nodules of calcium carbonate and fragments of partially weathered clay shale.

40 inches +, partially weathered red-colored Permian shale of the Ninnescah formation.

Rentide silt loam is a well-drained soil. Surface runoff is medium, permeability is moderate, and underdrainage is restricted by the underlying shales. Ground water moves laterally above the shale beds, but high water tables seldom develop, because the slopes are steep. Although the water-holding capacity of the soil is large, moisture stored in the fine-textured soil materials is slowly available to plants.

Rentide silt loam has fair tilth and is easily tilled throughout a wide range of moisture content. It is moderately susceptible to both wind and water erosion and, unless protected, gullies soon develop.

Rentide silt loam is moderately productive. It is best suited to small grains and sorghum or to other drought-resistant crops that mature early. The heavy clay subsoil restricts but does not prevent root development. The soil is slightly deficient in available phosphorus, and it is deficient in available nitrogen in areas where wheat has been grown for several years in succession. Only one unit was mapped in the county.

Rentide silt loam, 2 to 6 percent slopes (Ra; group 6A).—The profile of this soil is the same as that described for Rentide silt loam. Range site: clay upland.

RENTIDE SILTY CLAY LOAM

This soil has developed in areas once occupied by Rentide silt loam. Erosion removed the silt loam surface soil and exposed the silty clay loam. This soil occupies similar topographic positions, has the same kind of parent material, and has approximately the same drainage characteristics as Rentide silt loam. It differs mainly in having a thinner solum and lower rate of water infiltration through the finer textured surface layer.

Profile description of eroded Rentide silty clay loam:

0 to 8 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silty clay loam; hard when dry, friable when moist; weak medium granular structure; nearly neutral in reaction.

8 to 22 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; extremely hard when dry, very plastic when wet; moderately well developed medium blocky structure; nearly neutral in reaction.
22 to 30 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) silty clay; extremely hard when dry, very plastic when wet; weak coarse blocky structure; calcareous; contains concretions of calcium carbonate and fragments of partially weathered clay shale.
30 inches +, partially weathered, red Permian shales of Ninnescah formation.

Rentide silty clay loam cannot be tilled within so wide a range of moisture content as Rentide silt loam. It is very susceptible to both wind and water erosion. Because of its less favorable physical properties and loss of the fertile surface soil, it is less productive than Rentide silt loam. It is deficient in both available phosphorus and nitrogen. The addition of organic manures is particularly desirable in its management. Only one unit is mapped in the county.

Rentide silty clay loam, 2 to 6 percent slopes, eroded (Rc; group 6B).—The profile of this mapping unit is the same as that described for eroded Rentide silty clay loam. Range site: clay upland.

RENTIDE SILT LOAM, MODERATELY SHALLOW

This moderately deep, friable, reddish-brown soil of the uplands generally occurs on the crests and shoulders of hills and ridges in the south-central part of the county. It has developed in fine-textured materials that weathered from underlying red clay shales. The upper few inches of the parent materials may have been modified by loess deposits. The thickness of the parent materials above the calcareous, partially weathered shales usually is about 2 feet.

Profile description of moderately shallow Rentide silt loam:

0 to 7 inches, dark brown (7.5YR 3/2, dry) or dark reddish-brown (5YR 2/2, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine crumb or granular structure; nearly neutral in reaction.
7 to 12 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay loam; weak to moderate coarse granular structure; hard when dry, friable when moist; nearly neutral in reaction.
12 to 22 inches, reddish-brown (2.5YR 4/4, dry) or dark reddish-brown (2.5YR 3/3, moist) silty clay; extremely hard when dry, very plastic when wet; weak medium blocky structure; slightly alkaline.
22 to 26 inches, reddish-brown (5YR 5/4, dry) or (5YR 4/4, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weak coarse subangular blocky structure; calcareous; contains nodules of calcium carbonate and fragments of partially weathered shale.
26 inches +, reddish-brown (2.5YR 5/4, dry) or (2.5YR 4/4, moist) calcareous partially weathered Permian shale of the Ninnescah group.

This moderately shallow Rentide silt loam is well drained. Surface runoff is moderately rapid. Permeability is moderately slow, and underdrainage is restricted by the underlying shales. Ground water moves laterally above the underlying shale beds and occurs as seeps and springs where these beds are exposed at

lower levels. The water-storing capacity of the soil is fairly large, but some of the moisture stored in the fine-textured subsoil is slowly available to plants.

This soil possesses only fair tilth and can be tilled safely only within a narrow range of soil moisture content. It is very susceptible to water erosion, particularly gullying, and is moderately susceptible to wind erosion. The underlying shale beds restrict root development to the shallow solum, which is often droughty late in summer. Consequently, the soil is moderately productive and best used for permanent pasture. If the soil is cropped, the best suited crops are small grains and drought-resistant crops. Only one unit was mapped in the county.

Rentide silt loam, moderately shallow phase, 2 to 6 percent slopes (Rb; group 5A).—The profile of this mapping unit is the same as that described for moderately shallow Rentide silt loam. Range site: clay upland.

ROKEBY SILT LOAM

This deep, friable soil occurs mainly on old stream terraces in the central and southern parts of the county. It is developing in calcareous, fine-textured parent materials that were deposited as a mixture of alluvium and windlaid silts and clays. These materials average more than 5 feet in thickness and usually overlie other alluvial deposits of lighter texture.

Profile description of Rokeby silt loam:

0 to 6 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; moderate fine and medium crumb structure; slightly acid.

6 to 17 inches, gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderate coarse granular structure; slightly acid; soil aggregates have light-gray coatings (10YR 7/2) visible only when the soil is dry.

17 to 38 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; moderate to weak medium and coarse blocky structure; nearly neutral in reaction.

38 to 66 inches, pale-brown (10YR 6/3, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, very plastic when wet; massive to very weak coarse subangular blocky structure; calcareous; the upper part of this horizon contains concretions of calcium carbonate.

Rokeby silt loam is a moderately well drained to well drained soil. Surface runoff is very slow, and the soil may be ponded for short periods following heavy rains. Permeability is moderate and underdrainage is free. The water-storing capacity of the soil is large, but moisture stored in the fine-textured subsoil is slowly available to plants.

Rokeby silt loam has good tilth and is easily tilled throughout a fair range of moisture content. The soil is moderately productive and best suited to small grains or other crops that do not require large amounts of moisture late in summer. Its heavy claypan subsoil restricts the deep growth roots. When crops such as alfalfa are grown, the second cutting provides low yields and the stand thins rapidly after 2 or 3 years. Only one unit is mapped in the county.

Rokeby silt loam, 0 to 2 percent slopes (Rd; group 8A).—The profile of this mapping unit is the same as that described for Rokeby silt loam. Range site: lowland.

ROUGH BROKEN AND ROUGH STONY LAND, VERNON AND HEDVILLE SOIL MATERIALS

Rough broken and rough stony land, Vernon and Hedville soil materials (Re; group 24).—These irregular, steeply sloping areas occur mostly in the western part of the county and consist of slightly weathered exposures of clay shales, sandstones, and limestones. Small areas of alluvial-colluvial deposits are present along the foot slopes and in steeply sloping drainage channels. The complex soil pattern in these areas includes youthful Hedville and Vernon soil profiles and soil materials that show little evidence of soil development. The deeper soils occur on the alluvial-colluvial materials, but these areas make up a relatively small proportion of the entire soil complex.

These soil areas have limited value as grazing land. The grass cover usually is thin, and it is difficult for animals to graze the steep slopes. Large amounts of runoff from these areas are an erosion hazard to adjacent soils. Range site: breaks.

ROXBURY SILTY CLAY LOAMS

These deep, friable soils occur principally on the terraces along the Smoky Hill River in the central part of the county. In most areas they occupy nearly level to slightly concave surfaces. Where they occur adjacent to drainage channels, slopes are slightly steeper. The parent materials normally are 4 to 6 feet in thickness and consist of calcareous, silty clay loam alluvium. They are underlain by other alluvial deposits, generally of finer texture.

Profile description for uneroded Roxbury silty clay loams:

0 to 9 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; hard when dry, friable when moist; moderate fine granular structure; nearly neutral in reaction.

9 to 13 inches, gray (10YR 5/1, dry) or dark-gray (10YR 4/1, moist) silty clay loam; hard when dry, friable when moist; weak to moderate coarse granular or very fine subangular blocky structure; slightly alkaline.

13 to 42 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive to very weak medium and coarse subangular blocky structure; calcareous; contains concretions of calcium carbonate.

42 to 48 inches, pale-brown (10YR 6/3, dry) or brown (10YR 5/3, moist) light silty clay loam; hard when dry, friable when moist; massive; calcareous.

48 to 60 inches, light brownish-gray (10YR 6/2, dry) or grayish-brown (10YR 5/2, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive; calcareous.

Roxbury silty clay loams are moderately well drained. In most areas, surface runoff is very slow and temporary ponding may occur. Permeability is moderately slow, and underdrainage is restricted by the finer textured alluvial beds that underlie these soils. Although water tables are often present, they seldom are high enough to affect the growth of crops. Most of the moisture stored in these soils is available to plants.

Because of their poor tilth, Roxbury silt loams can be tilled only within a very narrow range of soil moisture content. If heavy equipment is used on these soils when they are wet, tillage pans will form. These soils are best suited to crops that can withstand wetness for short periods of time, but they are productive of most crops commonly grown.

Roxbury silty clay loam, 0 to 2 percent slopes (Rf; group 14A).—The profile of this mapping unit is the same as that described for uneroded Roxbury silty clay loams. Range site: lowland.

Roxbury silty clay loam, 2 to 6 percent slopes, eroded (Rg; group 14B).—The profile of this mapping unit is similar to that described for uneroded Roxbury silty clay loams, but 3 to 4 inches of the surface layer has been removed through erosion. This soil is less fertile and more susceptible to erosion than the more gently sloping, uneroded Roxbury silty clay loams. It frequently occurs as long, narrow, irregular bodies along shallow drainageways. Range site: lowland.

SALEMSBURG SILT LOAM

This deep, friable soil occurs on terraces along small streams in the central and southern parts of the county. The noncalcareous, silty, alluvial parent materials appear to be older than most terrace deposits in the county and also appear to have been deposited near their source. They normally are more than 5 feet thick and overlie other alluvial materials or bedrock.

Profile description of Salemsburg silt loam:

0 to 6 inches, gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) silt loam; soft when dry, very friable when moist; moderate fine crumb structure; moderately acid.

6 to 12 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) or very dark brown (10YR 2/2, moist) silty clay loam; hard when dry, friable when moist; moderately well developed medium and coarse granular structure; strongly acid.

12 to 26 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderately well developed medium subangular blocky structure; moderately acid.

26 to 32 inches, brown (10YR 5/3, dry) or grayish-brown (10YR 4/2, moist) heavy silt loam; hard when dry, friable when moist; weak coarse subangular blocky structure; moderately acid.

32 to 64 inches, pale-brown (10YR 6/3, dry) or brown (10YR 4/3, moist) silt loam; hard when dry, very friable when moist; massive; slightly acid to neutral in reaction.

Salemsburg silt loam is a well-drained soil. In most areas, surface runoff is slow, but ponding seldom occurs. Permeability is moderately rapid, and underdrainage is free. The soil has a large water-storing capacity, and most of the moisture stored is available to plants.

Salemsburg silt loam has good tilth and is resistant to erosion if carefully managed. It is a productive soil suited to all crops commonly grown. It is moderately acid and therefore requires lime to insure the best growth of legume crops. Only one unit was mapped in the county.

Salemsburg silt loam, 0 to 2 percent slopes (Sa; group 19A).—The profile of this mapping unit is that described for Salemsburg silt loam. Range site: lowland.

SHELLABARGER FINE SANDY LOAMS

These deep, friable soils of the uplands normally occur on the crests and slopes of hills and ridges bordering the Saline and Solomon Rivers. They are developing in deep, uniform, moderately sandy, wind-deposited materials. These materials were blown out of the river valleys and deposited on the adjacent uplands. They are usually more than 5 feet thick and overlie buried soils.

Profile description for uneroded Shellabarger fine sandy loams:

0 to 6 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) fine sandy loam; soft when dry, very friable when moist; weak fine granular structure; slightly acid.

6 to 18 inches, dark-brown (10YR 4/3, dry) or very dark grayish-brown (10YR 3/2, moist) loam; hard when dry, very friable when moist; moderate coarse granular structure; slightly acid.

18 to 36 inches, dark-brown (10YR 4/3, dry) or (10YR 3/3, moist) very fine sandy loam; slightly hard when dry, very friable when moist; very weak coarse subangular blocky structure; slightly acid.

36 to 60 inches, reddish-yellow (7.5YR 6/6, dry) or brown (7.5YR 4/4, moist) fine sandy loam; slightly hard to hard when dry, very friable when moist; massive; slightly acid.

Shellabarger fine sandy loams are well drained to somewhat excessively drained. Surface runoff is low, but most water falling on the soils is readily absorbed. Permeability is moderately rapid and underdrainage is free. Since these soils have a low water-storing capacity, they are frequently droughty late in summer.

Shellabarger fine sandy loams possess good tilth but are susceptible to both wind and water erosion. Unless the soils are carefully managed, gullies soon develop. They are moderately productive and best suited to drought-resistant crops that do not require large amounts of moisture late in summer. These soils are deficient in available phosphorus. They also are deficient in available nitrogen if they have been eroded or depleted through use.

Shellabarger fine sandy loam, 2 to 6 percent slopes (Sb; group 10B).—The profile of this mapping unit is the same as that described for uneroded Shellabarger fine sandy loams. Range site: sandy land.

Shellabarger fine sandy loam, 2 to 6 percent slopes, eroded (Sc; group 10B).—This soil differs from that described for uneroded Shellabarger fine sandy loams in having lost 2 to 4 inches of the surface layer through erosion. Range site: sandy land.

Shellabarger fine sandy loam, 2 to 6 percent slopes, severely eroded (Sd; group 10C).—This soil differs from that described for uneroded Shellabarger fine sandy loams in having lost more than 4 inches of the surface layer and, in some areas, part of the upper subsoil. Range site: sandy land.

SHELLABARGER LOAMS

These deep, friable soils of the uplands occur on the crests and side slopes of hills and ridges bordering the valleys of the Saline and Solomon Rivers. The parent materials are deep, uniform, moderately sandy, wind-deposited materials blown from the river valleys. They are usually more than 5 feet thick and overlie buried soils that occupied old land surfaces.

Profile description for uneroded Shellabarger loams:

0 to 12 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) loam; soft when dry, very friable when moist; moderate fine crumb structure; slightly acid.

12 to 18 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) loam; hard to slightly hard when dry, very friable when moist; moderate coarse granular to very fine subangular blocky structure; slightly acid.

18 to 24 inches, grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 3/2, moist) silt loam; slightly hard to hard when dry, very friable when moist; weak medium to coarse prismatic structure that breaks to moderately developed medium subangular blocks; slightly acid.

24 to 34 inches, yellowish-brown (10YR 3/4, dry) or brown (10YR 4/3, moist) sandy clay loam; hard when dry, friable when moist; weak to moderately developed medium prismatic structure that breaks to moderately developed medium subangular blocks; slightly acid.

34 to 48 inches, yellowish-brown (10YR 5/6, dry) or dark yellowish-brown (10YR 4/4, moist) heavy sandy loam; slightly hard when dry, very friable when moist; massive; slightly acid.

48 to 60 inches +, light yellowish-brown (10YR 6/4, dry) or yellowish-brown (10YR 5/4, moist) sandy loam; slightly hard when dry, very friable when moist; massive to single grained; slightly acid.

Shellabarger loams are well drained. Permeability is moderately rapid and underdrainage is free. High water tables seldom occur. The water-storing capacity of these soils is only moderate, but most of the water stored in them is available to plants.

Shellabarger loams have good tilth, but they are moderately susceptible to both wind and water erosion. They are particularly susceptible to gully erosion. The soils are productive and best suited to drought-resistant crops that do not require large amounts of soil moisture late in summer.

Shellabarger loam, 2 to 6 percent slopes (Se; group 10B).—The profile of this mapping unit is the same as that described for uneroded Shellabarger loams. Range site: loamy upland.

Shellabarger loam, 2 to 6 percent slopes, eroded (Sf; group 10B).—This soil has profile characteristics that are similar to those described for uneroded Shellabarger loams, but 4 to 6 inches of the surface layer has been removed by erosion. Range site: loamy upland.

Shellabarger loam, 2 to 6 percent slopes, severely eroded (Sg; group 10C).—This soil has profile characteristics that are similar to those of the uneroded phase, but 6 inches or more of the surface layer, and in some areas part of the upper subsoil layers, have been removed by erosion. Range site: loamy upland.

Shellabarger loam, 6 to 12 percent slopes, eroded (Sh; group 10E).—The profile of this mapping unit differs from that described for uneroded Shellabarger loams in having lost nearly half of the surface horizon. In some areas this soil occurs as narrow, elongated soil bodies along drainageways and on the crests and shoulders of hills and ridges. These areas are difficult to manage and should be seeded to grass. Range site: loamy upland.

SHELLABARGER SILT LOAMS

These deep, friable soils occur on high terraces and low upland slopes bordering the Smoky Hill and Solomon Rivers and along Gypsum Creek. The parent materials consist of deep, moderately fine textured, slightly sandy, alluvial materials that have been reworked by the wind. The reworked alluvial materials are older than the alluvial materials now present in the river valleys. They generally are more than 5 feet thick and overlie other alluvial deposits.

Profile description for uneroded Shellabarger silt loams:

0 to 8 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silt loam; soft when dry, very friable when moist; moderate fine granular structure; moderately acid.

8 to 24 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) loam; hard when dry, friable when moist; weak to moderate coarse prismatic structure that breaks to weak or moderate medium subangular blocks; moderately acid.

24 to 28 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) clay loam; hard when dry, friable when moist; weak to moderately developed medium prismatic structure that breaks to moderately developed medium subangular blocks; nearly neutral in reaction.

28 to 40 inches, brown (7.5YR 5/4, dry) or (7.5YR 4/4, moist) clay loam; hard when dry, friable when moist; weak medium and coarse subangular blocky structure; nearly neutral in reaction.

40 to 48 inches, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) fine sandy clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

48 to 70 inches, light yellowish-brown (10YR 6/4, dry) to yellowish-brown (10YR 5/4, moist) light fine sandy clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

Shellabarger silt loams are well drained. Both surface runoff and permeability are moderately rapid, and underdrainage is free. The water-storing capacity of this soil is large, and most of the water stored in them is available to plants.

Shellabarger silt loams possess fair tilth. They are moderately susceptible to both wind and water erosion. The soils are productive and suited to all crops commonly grown in the county.

Shellabarger silt loam, 0 to 2 percent slopes (Sk; group 10A).—This soil generally has surface soil and subsoil layers that are somewhat thicker and slightly lighter colored than those described as normal for uneroded Shellabarger silt loams. It also differs in having a slightly finer textured subsoil. Range site: loamy upland.

Shellabarger silt loam, 2 to 6 percent slopes (Sl; group 10B).—The profile of this mapping unit is the same as that described for uneroded Shellabarger silt loams. Range site: loamy upland.

Shellabarger silt loam, 2 to 6 percent slopes, eroded (Sm; group 10B).—The profile of this soil differs from that described for uneroded Shellabarger silt loams in having had 3 or 4 inches of the surface layer removed by erosion. Range site: loamy upland.

SMOKY BUTTE SILT LOAM

This deep, friable soil occurs on the terraces of the Saline River and on the terraces of streams that drain areas of sandstone and shale rock. The parent materials consist of thin alluvial deposits

of silty clay loam texture that overlie silt loam or loam materials at depths of 40 inches or more. The total thickness of these materials generally is more than 5 feet, and they overlie other alluvial materials.

Profile description of Smoky Butte silt loam:

0 to 6 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silt loam; soft when dry, very friable when moist; weak fine granular structure; slightly acid.

6 to 15 inches, brown (7.5YR 5/3, dry) or dark-brown (7.5YR 4/3, moist) silty clay loam; hard when dry, friable when moist; weak coarse granular or very fine subangular blocky structure; nearly neutral in reaction.

15 to 26 inches, brown (10YR 5/3, dry) or dark-brown (10YR 4/3, moist) silty clay loam; hard when dry, friable when moist; weak to moderate coarse subangular blocky structure; nearly neutral in reaction.

26 to 48 inches, reddish-yellow (7.5YR 6/6, dry) or strong-brown (7.5YR 5/6, moist) silty clay loam; massive to very weak coarse subangular blocky structure; nearly neutral in reaction.

48 to 60 inches, reddish-yellow (7.5YR 7/5, dry) or (7.5YR 6/5, moist) silt loam; hard when dry, very friable when moist; massive; approximately neutral in reaction.

Smoky Butte silt loam is well drained. Surface runoff generally is slow, but ponding normally does not occur. Permeability is moderately rapid to rapid and underdrainage is free. The soil has a large water-storing capacity, and most of the water stored in it is available to plants.

Smoky Butte silt loam possesses good tilth and is resistant to both wind and water erosion. It is productive and suited to all crops commonly grown in the county. Only one unit was mapped in the county.

Smoky Butte silt loam, 0 to 2 percent slopes (Sn; group 19A).—The profile of this mapping unit is the same as that described for Smoky Butte silt loam. Range site: lowland.

SMOLAN SILT LOAMS

These deep, friable soils of the uplands occur on the lower side slopes of hills and ridges, principally in the central and eastern parts of the county. The moderately fine textured, reddish parent materials are a mixture of wind deposits and outwash materials. The depth of these materials over bedrock is usually more than 6 feet.

Profile description for uneroded Smolan silt loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silt loam; soft when dry, very friable when moist; weak to moderate fine granular structure; nearly neutral in reaction.

6 to 12 inches, grayish-brown (10YR 5/2, dry) or light to dark grayish-brown (10YR 4/2, moist) light silty clay loam; slightly hard when dry, very friable when moist; moderate medium and fine granular structure; nearly neutral in reaction.

12 to 18 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; very hard when dry, very plastic when wet; strong, fine and very fine subangular blocky structure; slightly acid to neutral in reaction.

18 to 30 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/2, moist) silty clay; very hard when dry, firm when moist, and very plastic when wet; moderate, coarse and medium subangular blocky structure; nearly neutral in reaction.

30 to 41 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/3, moist) silty clay loam; hard when dry, friable when moist; weak, medium and coarse subangular blocky structure; the soil mass is usually noncalcareous but contains scattered, small, hard, round lime carbonate concretions.

41 to 58 inches, brown (7.5YR 5/4, dry) or dark-brown (7.5YR 4/4, moist) silty clay loam; hard when dry, friable when moist; massive; noncalcareous to mildly alkaline in reaction.

Smolan silt loams are well drained. Surface runoff is medium. Permeability is moderate and underdrainage is free. The soil has a large water-storing capacity, but moisture stored in the subsoil is slowly available to plants.

Smolan silt loams have fair tilth and are moderately resistant to erosion when properly managed. Their heavy-textured subsoils restrict the downward growth of roots at times, but not enough to prevent growth of deep-rooted crops that have good vigor. The soils are moderately productive and suited to all crops commonly grown in the area. They normally are deficient in available phosphorus, and they may be deficient in available nitrogen where wheat has been grown several years in succession.

Smolan silt loam, 2 to 6 percent slopes (So; group 9B).—The profile of this mapping unit is the same as that described for uneroded Smolan silt loams. Range site: clay upland.

Smolan silt loam, 2 to 6 percent slopes, eroded (Sp; group 9B).—The profile of this mapping unit differs from that described for uneroded Smolan silt loams in having had 2 to 3 inches of the surface layer removed by erosion. Range site: clay upland.

Smolan silt loam, 2 to 6 percent slopes, severely eroded (Sr; group 9C).—This soil differs from the other phases mapped in having lost, through erosion, 3 inches or more of the original surface layer. Almost all of the soil is gullied. Range site: clay upland.

SOLOMON CLAY

This deep, friable soil of the bottom lands occurs chiefly on the flood plains of the Smoky Hill, Saline, and Solomon Rivers. The parent materials are calcareous, fine-textured, alluvial deposits of recent age. These deposits are usually more than 6 feet thick, and they overlie older alluvial beds.

Profile description of Solomon clay:

0 to 3 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) clay; hard when dry, friable when moist; plastic when wet; weak fine granular structure; calcareous.

3 to 17 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; weak fine subangular blocky structure; calcareous.

17 to 30 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) clay; contains some small, indistinct, gray and dark-gray mottling; extremely hard when dry, very firm when moist, and extremely plastic when wet; massive or very weak fine subangular blocky structure; calcareous.

30 to 39 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) clay; extremely hard when dry, very firm when moist; and extremely plastic when wet; massive; calcareous; contains many small hard concretions of calcium carbonate.

39 to 54 inches +, variegated dark-gray (10YR 4/1, dry) and gray (10YR 5/1, dry) or very dark gray (10YR 3/1, moist) and dark-gray (10YR 4/1, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; massive; contains both disseminated lime carbonate and small, hard, concretions of calcium carbonate.

Solomon clay is a poorly drained soil. Surface runoff is very slow, and ponding usually occurs following heavy rains. Permeability is very slow, and underdrainage is slow enough to cause high water tables following heavy rains. Because of their positions, areas of Solomon clay are subject to overflow by streams and to accumulation of runoff from higher areas. Much of the water stored in the fine-textured soil is not available to plants.

Solomon clay has poor tilth and can be tilled only within a very narrow range of moisture content. It is moderately productive and is best suited to small grains or other crops that tolerate an excessively moist and poorly aerated soil. Crop losses may occur on this soil because it is too wet to permit harvesting. In spring the soil warms slowly and is low in available nitrogen. Topdressings of nitrogen fertilizer are frequently necessary at this time to stimulate plant growth. Only one unit was mapped in the county.

Solomon clay, 0 to 2 percent slopes (Ss; group 16).—The profile of this mapping unit is the same as that described for Solomon clay. Range site: lowland.

SOLOMON CLAY, LOW LIME VARIANT

This deep, friable soil occurs on low terraces and bottom lands along the Solomon River and along Gypsum Creek. It is developing in slightly alkaline, noncalcareous, heavy clay alluvial materials. These materials were transported from areas containing neutral to slightly acid soils and soil materials. They usually are more than 6 feet thick and overlie other alluvial materials.

Profile description of Solomon clay, low lime variant:

0 to 2 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) clay; hard when dry, friable when moist; weak to moderate fine granular structure; nearly neutral in reaction.

2 to 24 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) clay; massive to very weak medium blocky structure; mottled with strong brown (7.5YR 5/6); nearly neutral in reaction.

24 to 48 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; massive; slightly alkaline in reaction; soil mass generally is not calcareous but contains a few, scattered, small concretions of calcium carbonate.

This soil is poorly drained. In most areas runoff is very slow and ponding occurs following rainfall. Both permeability and underdrainage are slow. The soil is frequently flooded by stream overflow or ponded by the accumulation of runoff waters from higher areas. High water tables are often present. Because of its fine texture, much of the water stored in this soil is only slowly available to plants.

Solomon clay soil, low lime variant, has poor tilth and can be tilled only within a very narrow range of moisture content. The soil is unproductive and suited only to crops that are tolerant of excessive moisture and poor aeration. It is frequently too wet to allow harvesting of crops. Since the soil warms slowly in spring, crops may require topdressings of nitrogen fertilizer at that time to assure vigorous early growth. Only one unit was mapped in the county.

Solomon clay, low lime variant, 0 to 2 percent slopes (St; group 16).—The profile of this mapping unit is the same as that described for Solomon clay, low lime variant. Range site: lowland.

STIMMEL SILT LOAMS

These deep, friable soils occupy the old terraces along Mulberry, Spring, and Dry Creeks. They are developing in moderately fine textured, mottled parent materials that are believed to be a mixture of Loveland loess and alluvial deposits. These materials also are believed to be similar in age to the materials that underlie the Langley and Bonaccord soils. The parent materials generally are more than 6 feet thick and are sometimes stratified in their lower parts with lenses of loam or very fine sand.

Profile description for Stimmel silt loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or very dark gray (10YR 3/1, moist) silt loam; slightly hard when dry, very friable when moist; weak fine and very fine granular structure; medium acid.

6 to 9 inches, gray (10YR 5/1, dry) or dark-gray (10YR 3.5/1, moist) silt loam; soft when dry, very friable when moist; weak thin platy structure; medium acid.

9 to 16 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; very hard when dry, firm when moist, and very plastic when wet; weak medium columnar structure that breaks to strong medium blocky; slightly acid.

16 to 28 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) light silty clay; very hard when dry, firm when moist, and very plastic when wet; moderate medium and fine blocky structure; slightly acid.

28 to 34 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/1.5, moist) heavy silty clay loam; very hard when dry, firm when moist, and plastic when wet; massive or very weak fine blocky structure; mildly calcareous; contains a few, small, hard concretions of lime carbonate.

34 to 50 inches +, grayish-brown (2.5Y 5/2.5, dry) or olive-brown (2.5Y 4/3, moist) silty clay loam; hard when dry, friable when moist; massive; soil mass generally is noncalcareous but contains a few hard concretions of lime carbonate.

Stimmel silt loams are moderately well drained. Surface runoff usually is very slow, and ponding may occur following heavy rains. Permeability is moderately slow and underdrainage is slow. Although water tables occasionally are present, they seldom are high enough to cause damage to crops. Moisture stored in the fine-textured subsoils is not available to plants.

Stimmel silt loams have fair tilth and can be tilled over a moderate range of moisture content. They are easily damaged by overtillage or by improper tillage, but they are not susceptible to erosion if carefully managed. The soils are moderately productive, and most of the common crops can be grown. Early

maturing small grains and shallow-rooted crops are best suited because the soil has a heavy clay subsoil.

Stimmel silt loam, 0 to 2 percent slopes (Su; group 8A).—The profile of this mapping unit is the same as that described for Stimmel silt loams. Range site: lowland.

Stimmel silt loam, 2 to 6 percent slopes (Sv; group 8B).—This soil differs from that on 0 to 2 percent slopes in having a somewhat thinner and lighter colored surface layer and in having an upper subsoil layer that is sometimes very thin and indistinct. This soil frequently occurs as long, narrow, irregular-shaped areas on the sides of small, incipient drainageways. Range site: lowland.

STIMMEL SILTY CLAY LOAM

Stimmel silty clay loam has developed in areas once occupied by Stimmel silt loams. Erosion has caused loss of the silt loam surface soil, and this accounts for Stimmel silty clay loam. The soil has the same parent material and approximately the same drainage as Stimmel silt loams, but the finer textured surface layer slows infiltration of water.

Profile description of eroded Stimmel silty clay loam:

0 to 6 inches, gray (10YR 5/1, dry) or dark-gray (10YR 3.5/1, moist) silty clay loam; hard when dry, friable when moist; weak to medium fine subangular blocky structure; slightly acid; color and texture of surface layer are somewhat variable, depending upon the amount of material removed by erosion and the amount of upper subsoil material incorporated in the plow layer through tillage.

6 to 16 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; extremely hard when dry, firm when moist, and extremely plastic when wet; strong medium blocky structure; slightly acid.

16 to 28 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; moderate medium and fine blocky structure; slightly acid.

28 to 34 inches, grayish-brown (10YR 5/2, dry) to dark grayish-brown (10YR 4/2, dry) or dark grayish-brown (10YR 4/1.5, moist) heavy silty clay loam; very hard when dry, firm when moist, and very plastic when wet; massive to very weak fine blocky structure; mildly calcareous; contains a few small, hard concretions of lime carbonate.

34 to 60 inches +, grayish-brown (2.5Y 5/2.5, dry) or olive-brown (2.5Y 4/3, moist) silty clay loam; hard when dry, friable when moist; massive; generally noncalcareous but usually contains a few hard concretions of lime carbonate.

This soil has less favorable tilth than Stimmel silty loams and cannot be tilled throughout so wide a range of moisture content. It is less productive than Stimmel silt loams and requires more careful management to protect it from erosion. The use of manure is suggested to compensate for the decrease in organic-matter content. Most crops grown on this soil respond favorably to nitrogen fertilizer. Only one unit was mapped in the county.

Stimmel silty clay loam, 2 to 6 percent slopes, severely eroded (Sw; group 8C).—The profile of this mapping unit is similar to that described for eroded Stimmel silty clay loam. It usually occurs on the sloping sides of small drainage channels. Some gullying is nearly always present. Range site: lowland.

SUTPHEN SILTY CLAY

This deep, friable soil occurs on the low terraces and flood plains of the major rivers in the county. The parent materials are calcareous alluvial deposits of silty clay texture that overlie strata of coarser textured, friable, silty alluvium at depths of 8 or 10 feet. These materials are of recent age and generally overlie older alluvial deposits.

Profile description of Sutphen silty clay:

0 to 3 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist) silty clay; very hard when dry, very firm when moist, and very plastic when wet; moderate medium and fine granular structure; nearly neutral in reaction.

3 to 16 inches, very dark gray (10YR 2.5/1, dry) or black (10YR 2/1, moist) clay; very hard when dry, very firm when moist, and very plastic when wet; moderate and medium coarse granular structure; nearly neutral in reaction.

16 to 26 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; weak coarse and medium blocky structure; nearly neutral to mildly alkaline.

26 to 32 inches, grayish-brown (2.5Y 5/2, dry) or dark grayish-brown (2.5Y 3.5/2, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; massive; generally calcareous; contains a few hard, rounded concretions of calcium carbonate.

32 to 40 inches, pale-brown (10YR 6/2, dry) or brown (10YR 5/3, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; massive; calcareous.

40 to 60 inches +, light yellowish-brown (10YR 6/4, dry) or brown (10YR 5/3, moist) silty clay loam; hard when dry, friable when moist; massive; calcareous.

This is an imperfectly drained soil. In most areas surface runoff is very slow and ponding occurs following heavy rains. Both permeability and underdrainage are slow. High water tables are present at times. The soil is subject to flooding from stream overflow and to accumulation of runoff from adjacent upland slopes. Because of its fine texture, much of the water stored in this soil is slowly available to plants.

Sutphen silty clay has fair tilth and is easily tilled, even though its texture is fine. However, tillage is limited to a narrow range of moisture content. The use of heavy equipment should be avoided when the soil is wet.

The soil is moderately productive and best suited to crops that are tolerant of short periods of wetness and poor aeration. Since the soil warms slowly in spring, topdressings of nitrogen fertilizers are needed to increase the supply of available nitrogen at that time. Only one unit was mapped in the county.

Sutphen silty clay, 0 to 2 percent slopes (Sx; group 15).—The profile of this mapping unit is the same as that described for Sutphen silty clay. Range site: lowland.

TESCOTT SILT LOAM

This deep, friable soil occurs on small upland flats and in concave drainheads, principally in the western part of the county. The fine-textured, reddish-colored, neutral to slightly alkaline parent materials have weathered from Cretaceous clay shales of the Terra Cotta clay member. The thickness of the parent materials over the Terra Cotta beds is about 4 to 5 feet.

Profile description of Tescott silt loam soil:

0 to 8 inches, dark grayish-brown (10YR 4/2.5, dry) or very dark grayish-brown (10YR 3/2, moist) silt loam; soft when dry, very friable when moist; weak fine granular structure; slightly acid.

8 to 16 inches, brown (7.5YR 4.5/4, dry) or dark-brown (7.5YR 4/3, moist) silty clay loam; slightly hard when dry, friable when moist; moderate coarse granular structure; slightly acid.

16 to 26 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; very hard when dry, firm when moist, and very plastic when wet; weak coarse blocky structure; slightly acid to medium acid.

26 to 32 inches, reddish-brown (5YR 4/4, dry) to dark reddish-brown (5YR 3/4, moist) silty clay; contains a few faint small mottles of reddish gray; very hard when dry, firm when moist, and very plastic when wet; strong medium and fine blocky structure; slightly to medium acid.

32 to 42 inches, mixed reddish-brown (5YR 4/4, dry) and dark reddish-brown (5YR 3/3, dry) to dark reddish-brown (5YR 3.5/2, dry) or (5YR 3.5/4, moist) silty clay; very hard when dry, firm when moist, and very plastic when wet; weak fine subangular blocky structure; slightly acid.

42 to 48 inches, strongly mixed brown colors (7.5YR 5/3, dry) and reddish-brown (5YR 5/5, dry) or dark-brown (7.5YR 4/3, moist) and reddish-brown (5YR 4/5, moist) clay; extremely hard when dry, very firm when moist, and very plastic when wet; massive; neutral to mildly alkaline.

48 to 60 inches +, strongly mottled grayish-yellow and reddish-brown silty clay or clay shale of Cretaceous age.

Tescott silt loam is a well-drained soil. In most areas surface runoff is slow to medium but permeability is moderately rapid, and water readily penetrates the soil. Underdrainage is restricted by the underlying shales, which cause ground waters to move laterally above them. Seeps and springs occur at lower levels.

Tescott silt loam has fair tilth and can be tilled easily by conventional machinery throughout a moderate range of moisture content. The soil is susceptible to water erosion, particularly gullying, and is moderately susceptible to wind erosion. The soil is moderately productive and best suited to early maturing, drought-resistant crops. It is deficient in phosphorus and may be deficient in nitrogen if badly eroded or depleted by continuous cropping. Only one unit was mapped in the county.

Tescott silt loam, 2 to 6 percent slopes (Ta; group 4A).—The profile of this mapping unit is the same as that described for Tescott silt loam. Range site: clay upland.

TESCOTT SILTY CLAY LOAM

This deep soil occurs in areas where Tescott silt loam has been seriously eroded. It is developing on the same kind of parent materials as Tescott silt loam and it occupies similar topographic positions. Because this soil has a fine-textured surface layer, the rate of water infiltration is slower than in Tescott silt loam.

Profile description of eroded Tescott silty clay loam:

0 to 8 inches, brown (7.5YR 4.5/4, dry) or dark-brown (7.5YR 4/3, moist) silty clay loam; slightly hard when dry, friable when moist; moderate coarse granular structure; slightly acid; color and texture of surface layer vary somewhat from place to place depending upon the amount of erosion.

8 to 18 inches, reddish-brown (5YR 4/3, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; very hard when dry, firm when moist, and very plastic when wet; weak coarse blocky structure; slightly to medium acid.

18 to 24 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) silty clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; moderate to strong medium and fine blocky structure; slightly to medium acid.

24 to 34 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3.5/2, moist) silty clay, strongly mottled with shades of gray and more brilliant red; extremely hard when dry, firm when moist, and very plastic when wet; weak fine subangular blocky structure; slightly acid.

34 to 40 inches, mixed brown (7.5YR 5/3, dry) and reddish-brown (5YR 5/5, dry) or dark-brown (7.5YR 4/3, moist) and reddish-brown (5YR 4/4, moist) clay; extremely hard when dry, very firm when moist, and plastic when wet; neutral to mildly alkaline.

40 to 60 inches +, mottled grayish-yellow and reddish-brown silty clay or clay shale of Cretaceous age.

Tescott silty clay loam has less favorable tilth, cannot be worked over as wide a range of soil moisture content, and is less fertile and more susceptible to erosion than Tescott silt loam. It is deficient in both available phosphorus and nitrogen. Only one unit was mapped in the county.

Tescott silty clay loam, 2 to 6 percent slopes, eroded (Tb; group 4B).—The profile of this mapping unit is that described for eroded Tescott silty clay loam. Range site: clay upland.

TOBIN SILT LOAMS

These deep, friable soils occur on narrow terraces and flood plains along the larger intermittent streams in the western part of the county. The parent materials are noncalcareous, medium-textured, alluvial deposits of recent age. They are generally more than 6 feet thick and overlie other alluvial deposits.

Profile description for Tobin silt loams:

0 to 6 inches, dark grayish-brown (10YR 4/1.5, dry) or very dark brown (10YR 2/2, moist) silt loam; soft when dry, very friable when moist; weak fine granular structure; medium acid.

6 to 9 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2.5/2, moist) silt loam; soft when dry, very friable when moist; weak medium granular structure; medium acid.

9 to 16 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2.5/2, moist) light silty clay loam; hard when dry, friable when moist; moderate very fine subangular blocky structure; slightly acid.

16 to 22 inches, dark grayish-brown (10YR 4/2, dry) or very dark grayish-brown (10YR 3/2, moist) silt loam; hard when dry, friable when moist; weak very fine subangular blocky structure; slightly acid.

22 to 47 inches, grayish-brown (10YR 5/2.5, dry) or very dark grayish-brown (10YR 3/2, moist) loam; slightly hard when dry, very friable when moist; very weak very fine subangular blocky structure; neutral to slightly acid.

47 to 60 inches +, brown (10YR 5/3, dry) or dark grayish-brown (10YR 4/2, moist) loam or silt loam; slightly hard when dry, friable when moist; massive; neutral to mildly alkaline.

Tobin silt loams are well drained. In most areas surface runoff is slow, but water is rapidly absorbed by the soil. Permeability is moderately rapid and underdrainage is free. The soils have a large water-storing capacity, and most of the water stored in them is available to plants. The soils are subject to occasional overflow, but crop losses resulting from overflow are infrequent.

Tobin silt loams possess good tilth and are easily tilled over a fairly wide range of moisture content. They are productive and suited to all crops commonly grown in the county.

Tobin silt loam, 0 to 2 percent slopes (Tc; group 19A).—The profile of this mapping unit is the same as that described for Tobin silt loams. Range site: lowland.

Tobin silt loam, 2 to 6 percent slopes (Td; group 19B).—The profile of this soil differs from that described for Tobin silt loams in having a somewhat thinner surface layer. It usually occurs as long, narrow, irregular-shaped areas along the sides of small drainageways. Range site: lowland.

VERNON SILTY CLAY LOAMS

These shallow soils of the uplands usually occur on the crests and shoulders of hills and ridges, principally in the southern part of the county. They are developing in thin, reddish-brown, fine-textured materials that weathered from the underlying Permian clay shales of the Ninnescah formation. The materials generally are about 12 to 14 inches thick and are underlain by unweathered or partially weathered clay shales.

Profile description for uneroded Vernon silty clay loams:

0 to 5 inches, dark reddish-brown (2.5YR 3/4, dry) or dark reddish-brown (5YR 3/3, moist) silty clay loam; soft when dry, very friable when moist; moderately developed medium granular structure; nearly neutral in reaction.

5 to 14 inches, dark reddish-brown (2.5YR 4/4, dry) or dark reddish-brown (5YR 3/3, moist) silty clay; very hard when dry, extremely plastic when wet; massive; slightly alkaline to calcareous.

14 to 24 inches +, reddish-brown (2.5Y 4/4, dry) or dark reddish-brown (2.5YR 3/4, moist) fine-textured, calcareous clay shales of Permian age.

Vernon silty clay loams are well drained to somewhat excessively drained. Surface runoff is very rapid. Much of the water falling on these soils is lost as runoff. Permeability is slow, and underdrainage is restricted by the underlying shale. The soils have a low water-storing capacity and are frequently droughty late in summer. Ground water moves laterally above the underlying shales and occurs as seeps and springs at lower levels.

Vernon silty clay loams are unproductive soils. They are low in fertility and are very susceptible to erosion. They are best used as permanent pasture, but they are sometimes tilled where they occur with deeper soils. They are deficient in both available phosphorus and nitrogen.

Vernon silty clay loam, 2 to 6 percent slopes (Va; group 1A).—The profile of this mapping unit is the same as that described for uneroded Vernon silty clay loams. Range site: shallow land.

Vernon silty clay loam, 2 to 6 percent slopes, severely eroded (Vb; group 1B).—This soil differs from that described as normal for uneroded Vernon silty clay loams in having lost nearly all of the surface layer through erosion. Gullying is present nearly everywhere. Range site: shallow land.

Vernon silty clay loam, 6 to 12 percent slopes (Vc; group 1A).—This soil has a thinner surface layer than that described for uneroded Vernon silty clay loams. The depth of soil and parent material over the bedrock shales usually is less than 10 inches. Range site: shallow land.

WABASH SILTY CLAY LOAM

This deep, friable, alluvial soil occurs on the low terraces and flood plains along the Solomon River and along Gypsum Creek. It has developed in neutral to slightly alkaline, fine-textured alluvium of recent age. The parent material generally is more than 6 feet thick.

Profile description of Wabash silty clay loam:

0 to 8 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay loam; slightly hard when dry, very friable when moist; moderate medium and coarse granular structure; slightly acid.

8 to 24 inches, very dark gray (10YR 3/1, dry) or black (10YR 2/1, moist) silty clay; hard when dry, friable when moist, and extremely plastic when wet; weak to moderate fine and very fine subangular blocky structure; nearly neutral in reaction.

24 to 32 inches, dark-gray (10YR 4/1, dry) or very dark gray (10YR 3/1, moist) silty clay; very hard when dry, firm when moist, and extremely plastic when wet; weak fine subangular blocky structure; nearly neutral in reaction.

32 to 48 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown (10YR 4/2, moist) silty clay; very hard when dry, firm when moist, and extremely plastic when wet; massive; nearly neutral in reaction.

Wabash silty clay loam is an imperfectly drained soil. Surface runoff is slow in most areas, and water stands on the surface following rains. However, surface drainage is rapid enough to prevent serious crop loss from ponding. Permeability and underdrainage are moderately slow. The water-storing capacity of the soil is large, but some of the moisture stored in the fine-textured subsoil is not available to plants. Water tables may be present during periods of excessive rainfall. The soil also is subject to occasional stream overflow.

Wabash silty clay loam is a moderately productive soil. Because it is imperfectly drained, it is best suited to crops that can withstand a wet, poorly aerated soil for periods of time. Tillage also is limited to a narrow range of soil-moisture content. The soil usually is deficient in available nitrogen in the spring when cold, wet weather prevails. Only one unit was mapped.

Wabash silty clay loam, 0 to 2 percent slopes (Wa; group 15).—The profile of this mapping unit is that described for Wabash silty clay loam. Range site: lowland.

WESTFALL SILT LOAM

This deep, friable soil of the uplands usually occurs on the lower foot slopes of hills and ridges, principally in the western and northern parts of the county. The soil is developing in friable, reddish-colored materials that weathered from clay shales and sandstones. The upper few inches of these materials may have been modified by loess deposits or loess materials carried from

surrounding areas by runoff waters. The thickness of the parent materials over the Cretaceous clay shales and sandstones generally is about 4 or 5 feet.

Profile description of Westfall silt loam:

0 to 8 inches, dark grayish-brown (10YR 4/2, dry) or very dark brown (10YR 2.5/2, moist) silt loam; soft when dry, very friable when moist; moderate medium and fine granular structure; slightly to medium acid.

8 to 18 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) clay loam or silty clay loam; hard when dry, friable when moist; moderate very fine subangular blocky structure; slightly acid to medium acid.

18 to 30 inches, reddish-brown (6YR 4.5/4, dry) or dark reddish-brown (6YR 3.5/4, moist) heavy silty clay loam or light silty clay; very hard when dry, firm when moist; weak medium prismatic structure that breaks to moderate medium blocks, slightly acid to neutral.

30 to 42 inches, reddish-brown (5YR 5/5, dry) or (5YR 4/4, moist) clay loam; hard when dry, firm when moist; weak medium blocky structure; nearly neutral in reaction.

42 to 60 inches +, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) clay loam; hard when dry, friable when moist; massive; nearly neutral in reaction.

Westfall silt loam is well drained. Surface runoff in most areas is moderate. Permeability is moderate and underdrainage is free. Ground waters tend to move laterally above the underlying shales. The soil has a large water-storing capacity, and most of the water stored is available to plants.

Westfall silt loam has good tilth and can be tilled with conventional machinery throughout a fair range of moisture content. The soil is moderately susceptible to both wind and water erosion and is particularly susceptible to gullying. Also, it occupies positions where runoff waters from higher slopes tend to collect.

Westfall silt loam is moderately productive. Most crops common to the area can be grown on it. Legume crops do best when limed. Better crop yields are obtained if phosphate fertilizer is added, and areas that have been eroded or improperly managed generally need nitrogen fertilizer.

Westfall silt loam, 2 to 6 percent slopes (Wb; group 3A).—The profile of this mapping unit is that described for Westfall silt loam. Range site: loamy upland.

WESTFALL SILTY CLAY LOAMS

These soils occur in areas where Westfall silt loam has been seriously eroded. Both soil types occupy similar topographic positions and have the same kind of parent materials. They also have similar drainage characteristics, but the rate of infiltration is slower on Westfall silty clay loams because of their finer textured surface layers.

Profile description of eroded Westfall silty clay loam:

0 to 10 inches, dark-brown (7.5YR 4/2, dry) or (7.5YR 3/2, moist) silty clay loam; slightly hard when dry, friable when moist; moderate very fine subangular blocky structure; slightly to medium acid; color and texture of surface layer vary, depending upon amount of erosion.

10 to 22 inches, reddish-brown (6YR 4.5/4, dry) or dark reddish-brown (6YR 3.5/4, moist) heavy silty clay loam or light silty clay; very hard when dry, firm when moist; weak medium prismatic structure that breaks to moderate medium blocky; slightly acid to neutral in reaction.

22 to 34 inches, reddish-brown (5YR 5/5, dry) or (5YR 4/4, moist) clay loam; hard when dry, firm when moist; weak medium blocky structure; nearly neutral in reaction.

34 to 60 inches +, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) clay loam; slightly hard to hard when dry, friable when moist; massive; nearly neutral in reaction.

Westfall silty clay loams cannot be tilled through so wide a range of moisture content as Westfall silt loam. They are very susceptible to erosion, particularly by water. Because they have lost their fertile surface soil, they are less productive than Westfall silt loam. They are deficient in both available phosphorus and available nitrogen. The use of manures is particularly desirable in the management of these soils.

Westfall silty clay loam, 2 to 6 percent slopes, eroded (Wc; group 3A).—The profile of this mapping unit is the same as that described for eroded Westfall silty clay loam. Range site: loamy upland.

Westfall silty clay loam, 2 to 6 percent slopes, severely eroded (Wd; group 3C).—The profile of this soil differs from that described as normal for eroded Westfall silty clay loam in having had 4 inches or more of the surface layer and, in some places, part of the upper subsoil layer removed by erosion. Normally there is some gullying in this soil. Range site: loamy upland.

WINDOM FINE SANDY LOAMS

These deep, friable soils occur principally on the terraces of Spring, Mulberry, and Gypsum Creeks. They are developing in fine sandy clay loam alluvial deposits of recent age. These parent materials generally are more than 6 feet thick and overlie other alluvial deposits.

Profile description for Windom fine sandy loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1.5, moist) fine sandy loam; soft when dry, very friable when moist; weak fine granular structure; slightly acid.

6 to 24 inches, grayish-brown (10YR 4/2, dry) to dark grayish-brown (10YR 3/2, moist) light fine sandy clay loam; hard when dry, very friable to friable when moist; weak to moderate medium and coarse subangular blocky structure; nearly neutral in reaction.

24 to 32 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) light fine sandy clay loam; hard when dry, friable when moist; massive to very weakly developed coarse subangular blocky structure; nearly neutral in reaction.

32 to 48 inches +, yellowish-brown (10YR 5/4, dry) or dark yellowish-brown (10YR 4/4, moist) heavy fine sandy loam; slightly hard when dry, friable when moist; massive; nearly neutral.

Windom fine sandy loams are well drained. In most areas surface runoff is medium to slow, but ponding seldom occurs. Permeability is moderate to rapid and underdrainage is free. These soils have a large water-storing capacity, and most of the water stored in them is readily available to plants.

Windom fine sandy loams have good tilth and can be tilled within a rather wide range of moisture content. They are susceptible to wind erosion but generally are not susceptible to water erosion. The soils are moderately productive. They are best suited to sorghum and crops that have deep roots or that do not require large amounts of moisture late in summer. The soils are low in available phosphorus. Most crops, and particularly alfalfa, respond well if phosphate fertilizer is applied. Since these soils also are somewhat low in organic matter, the management of crop residues is very important.

Windom fine sandy loam, 0 to 2 percent slopes (We; group 18A).—The profile of this mapping unit is the same as that described for Windom fine sandy loams. Range site: lowland.

Windom fine sandy loam, 2 to 6 percent slopes (Wf; group 18B).—The profile of this mapping unit is similar to that described for Windom fine sandy loams. This soil usually occurs as long, narrow, irregular-shaped areas on the sides of drainage channels or in areas of uneven relief. Range site: lowland.

WINDOM LOAMS

These deep, friable soils occur principally on the terraces of larger streams in the western part of the county. The soil materials consist of friable sandy clay loam alluvium of recent age. These materials generally are more than 5 feet thick and overlie older alluvial deposits. Some stratification usually occurs at depths of 4 feet or more.

Profile description for Windom loams:

0 to 6 inches, grayish-brown (10YR 5/2, dry) or very dark brown (10YR 2/2, moist) loam; soft when dry, very friable when moist; weak very fine granular structure; strongly acid.

6 to 18 inches, dark-gray (10YR 4/1.5, dry) or very dark brown (10YR 2/2, moist) clay loam; slightly hard when dry, firm when moist; weak very fine subangular blocky structure that breaks to coarse granular; medium acid.

18 to 31 inches, dark-brown (7.5YR 4/2, dry) or dark reddish-brown (5YR 3/2, moist) loam or clay loam; slightly hard to hard when dry, friable when moist; very weak very fine subangular blocky structure; medium acid.

31 to 48 inches, brown (7.5YR 5/3, dry) or dark reddish-brown (5YR 3/3, moist) sandy clay loam or heavy fine sandy loam; slightly hard when dry, very friable when moist; massive; slightly acid to alkaline.

Windom loams are well drained. Surface runoff in most areas is very slow, but the soils absorb water readily, and ponding seldom occurs. Permeability is moderately rapid and underdrainage is free. The soils have a large water-storing capacity. They are subject to occasional stream overflow, but crops seldom are damaged.

Windom loams have good tilth, are easily tilled within a fairly wide range of moisture content, and are only moderately susceptible to erosion if carefully managed. The soils are productive and suited to all the crops commonly grown. Although Windom loams generally are neutral to slightly alkaline, a few areas have calcareous subsoils below depths of 30 inches.

Windom loam, 0 to 2 percent slopes (Wg; group 18A).—The profile of this mapping unit is the same as that described for Windom loams. This soil occurs on nearly level to very gently sloping terraces. Range site: lowland.

Windom loam, 2 to 6 percent slopes (Wh; group 18B).—The profile of this mapping unit is the same as that described for Windom loams. This soil frequently occurs in long, narrow, irregular-shaped areas along the sides of small drainageways. These areas generally are small and are difficult to manage as separate units. Range site: lowland.

WINDOM LOAMY FINE SANDS, SANDY SUBSTRATUM VARIANT

These deep, loose, friable sandy soils occur principally on the terraces of streams that drain the Cretaceous sandstone and shale areas in the western part of the county. The parent materials are friable, noncalcareous, loamy fine sand alluvium. These materials probably were deposited as natural levees along old drainage channels. Since they were deposited they have been partially reworked by wind. They usually are 5 feet or more in thickness and are underlain by other alluvial materials.

Profile description for Windom loamy fine sands, sandy substratum variant:

0 to 8 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/1.5, moist) loamy fine sand; soft when dry, very friable when moist; single-grained to very weak very fine granular structure; slightly acid.

8 to 16 inches, grayish-brown (10YR 5/2.5, dry) or very dark grayish-brown (10YR 3/2, moist) loamy fine sand; soft when dry, very friable when moist; weak fine granular structure; slightly acid.

16 to 26 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) fine sandy loam; slightly hard when dry, very friable when moist; massive to very weak coarse subangular blocky structure; slightly acid.

26 to 40 inches, brown (10YR 5/3, dry) or (10YR 4/3, moist) sandy clay loam, stratified with loamy fine sand; massive to very weak coarse and medium subangular blocky structure; hard when dry, friable when moist; nearly neutral in reaction.

40 to 60 inches, light yellowish-brown (10YR 6/5, dry) to brown (10YR 5/3, moist) loamy fine sand; loose when dry, very friable when moist; massive to single grained; nearly neutral in reaction.

These sandy soils are excessively drained. Surface runoff is very slow in most areas, but permeability is rapid, and underdrainage is free. Water is readily absorbed. The soils have a low water-storing capacity and tend to be droughty during the latter part of the growing season.

These soils are easily tilled throughout a wide range of moisture content. Overtillage should be avoided, however, as it leaves the soils loose. The soils are very susceptible to wind erosion and must be carefully managed to prevent blowing during the dry season. The soils are unproductive and best suited to drought-resistant crops. They are low in both available phosphorus and nitrogen. They are sufficiently acid that growth of root-nodule bacteria is impaired when legumes are grown.

Windom loamy fine sand, sandy substratum variant, 0 to 2 percent slopes (Wk; group 22A).—The profile of this mapping unit is the same as that described for Windom loamy fine sands, sandy

substratum variant. This soil occurs in nearly level to very gently sloping areas. Range site: sandy land.

Windom loamy fine sand, sandy substratum variant, 2 to 6 percent slopes (WI; group 22A).—This soil has the same profile characteristics as those described above. It occurs on steeper slopes and frequently on the faces of terrace breaks. The areas are irregularly shaped and difficult to manage separately. Range site: sandy land.

YORDY LOAMS

These deep soils usually occupy the crests of low, winding ridges in the south-central and eastern parts of the county. They are developing in friable, reddish-brown silty clay loam materials that appear to be a mixture of outwash materials weathered from Cretaceous beds and wind-deposited materials of Loveland age. They overlie beds of Cretaceous ironstone and sandstones, fragments and channers of shale, all of which are imbedded in a matrix of silty clay loam. The deposits in the substratum probably were laid down in the channels of streams that were eroding the Cretaceous beds. The thickness of the silty materials generally ranges from 3 to 4 feet. The thickness of the underlying coarse-textured channery beds varies, but the beds generally extend to depths of 6 feet or more.

Profile description for Yordy loams:

0 to 6 inches, brown (7.5YR 4/2, dry) or dark-brown (7.5YR 3/2, moist) loam; soft when dry, very friable when moist; moderate fine granular structure; slightly acid.

6 to 14 inches, dark-gray (7.5YR 4/1, dry) or very dark gray (7.5YR 3/1, moist) silty clay loam; slightly hard when dry, friable when moist; moderate medium granular structure; medium acid.

14 to 25 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) silty clay loam; hard when dry, friable when moist; moderate medium prismatic structure that breaks to moderate medium subangular blocky; slightly acid.

25 to 38 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3.5/4, moist) silty clay loam; hard when dry, friable when moist; weak medium subangular blocky structure; contains a few, small ironstone pebbles; nearly neutral in reaction.

38 to 48 inches +, yellowish-red (5YR 5/6 dry) or (5YR 4/6, moist) ironstone and Cretaceous channers imbedded in a silty clay loam matrix; hard when dry, friable when moist; massive; nearly neutral in reaction.

Yordy loams are well drained. Surface runoff is medium in most areas but does not prevent good penetration. Permeability is moderately rapid, and underdrainage is free. The soils have moderate water-storing capacities, and most of the water stored in them is available to plants.

Yordy loams can be tilled throughout a fair range of moisture content. They are susceptible to both wind and water erosion, and particularly gullying. The soils are often droughty late in summer and are only moderately productive. They are best suited to crops that mature early or to crops that are drought resistant. These soils are deficient in available phosphorus and, in badly eroded areas or where the soil is depleted, in available nitrogen.

Yordy loam, 2 to 6 percent slopes (Ya; group 11A).—The profile description of this mapping unit is the same as that described as normal for Yordy loams. Range site: loamy upland.

Yordy loam, 6 to 12 percent slopes (Yc; group 11B).—This soil differs from that described as normal for Yordy loams in having a somewhat thinner surface soil and an average combined thickness of silty material, over the coarse-textured substratum of about 30 inches. Range site: loamy upland.

YORDY LOAMS, SHALLOW

These shallow soils occur principally in the uplands in the central and south-central parts of the county. They usually occupy the crests of low, winding ridges. The soils are developing in thin deposits of moderately fine textured materials. These deposits are a mixture of outwash from Cretaceous beds and silty loess of Loveland age. They overlie beds of ironstone and Cretaceous sandstone or shale channers imbedded in a matrix of silty clay loam. The underlying beds are believed to have been deposited by swift streams that were eroding Cretaceous beds in surrounding areas. The silty materials generally are about 20 to 24 inches thick. The bed of channers usually extends to depths of 6 feet or more.

Profile description for shallow Yordy loams:

0 to 5 inches, grayish-brown (10YR 5/2, dry) or dark-gray (10YR 4/1, moist) loam; soft when dry, very friable when moist; moderately developed fine granular structure; slightly acid.

5 to 22 inches, brown (7.5YR 5/2, dry) or (7.5YR 4/2, moist) silty clay loam; weak to moderate, medium and coarse subangular blocky structure; hard when dry, friable when moist; nearly neutral in reaction.

22 to 48 inches +, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) ironstone pebbles and flat stones imbedded in a matrix of silty clay loam; massive; slightly hard when dry, very friable when moist; nearly neutral in reaction.

Shallow Yordy loams are somewhat excessively drained. Surface runoff is medium in most areas. Permeability is moderately rapid in the silty materials, and underdrainage is free. Because the silty materials are shallow, the soils are not able to store enough moisture for plant growth late in summer.

Shallow Yordy loams can be tilled by conventional machinery throughout a fair range of moisture content. When tilled, however, they are very susceptible to wind and water erosion. They are relatively unproductive and should be retired from cultivation. If tilled, they are best suited to wheat or sorghums. The soils are low in available phosphorus and are more easily depleted by poor management than most upland soils.

Yordy loam, shallow phase, 2 to 6 percent slopes (Yb; group 11A).—The profile of this mapping unit is the same as that described for shallow Yordy loams. Range site: loamy upland.

Yordy loam, shallow phase, 6 to 12 percent slopes (Yd; group 11B).—The profile of this mapping unit is similar to that described for shallow Yordy loams, but the surface soil is somewhat thinner, and the combined thickness of the surface layer and subsoil layers rarely exceeds 14 to 16 inches. Range site: loamy upland.

YORDY SILTY CLAY LOAM

This moderately deep soil occurs in areas once occupied by Yordy loams. It differs from Yordy loams in having silty clay loam at the surface. Water penetrates the fine-textured surface layer more slowly than it does that of Yordy loams, and there is also less depth of silty materials in which moisture can be stored.

Profile description of eroded Yordy silty clay loam:

0 to 6 inches, dark-gray (7.5YR 4/1, dry) to very dark gray (10YR 3/1, moist) silty clay loam; slightly hard when dry, very friable when moist; moderate medium granular structure; medium acid; color and texture of surface layer vary, depending upon the amount of erosion.

6 to 19 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3/4, moist) silty clay loam; hard when dry, friable when moist; moderate medium prismatic structure that breaks to medium subangular blocky; slightly acid.

19 to 29 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (5YR 3.5/4, moist) silty clay loam; hard when dry, very friable when moist; weak medium subangular blocky structure; nearly neutral in reaction; contains a few ironstone pebbles.

29 inches +, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) ironstone pebbles and Cretaceous channers imbedded in a silty clay matrix; slightly hard when dry, friable when moist; massive; nearly neutral in reaction.

Yordy silt clay loam is less productive than Yordy loams. It cannot be tilled throughout as wide a range of moisture content and is more susceptible to erosion. It is deficient in both available phosphorus and available nitrogen.

Yordy silty clay loam, 2 to 6 percent slopes, eroded (Ye; group 11A).—The profile of this mapping unit is that described for eroded Yordy silty clay loam. Range site: loamy upland.

YORDY SILTY CLAY LOAM, SHALLOW

This moderately deep soil occurs in areas once occupied by shallow Yordy loams. Its water-storing capacity is lower than that of shallow Yordy loams, because the fine-textured surface layer has nearly the same composition as the subsoil of the shallow Yordy loams. The silty materials are shallower than for the Yordy loams, and they overlie the coarse, open, channery substratum.

Profile description of eroded shallow Yordy silty clay loam:

0 to 17 inches, brown (7.5YR 5/2, dry) or (7.5YR 4/2, moist) silty clay loam; slightly hard to hard when dry, friable when moist; weak fine and medium subangular blocky structure; nearly neutral in reaction; color and texture of the first few inches of this layer varies, depending upon the amount of erosion.

17 to 60 inches +, yellowish-red (5YR 5/6, dry) or (5YR 4/6, moist) ironstone pebbles and Cretaceous channers imbedded in a matrix of silty clay loam; massive; slightly hard when dry, very friable when moist; nearly neutral in reaction.

This soil is less productive, has poorer tilth, and is more susceptible to wind and water erosion than shallow Yordy loams. It is low in both available phosphorus and available nitrogen. Only one unit was mapped in the county.

Yordy silty clay loam, shallow phase, 2 to 6 percent slopes, eroded (Yf; group 11A).—The profile of this mapping unit is that described for eroded shallow Yordy silty clay loam. Range site: loamy upland.

USE AND MANAGEMENT OF THE SOILS

This section of the report consists of three parts: (1) Management problems and practices common to most soils; (2) management of native pasture by range sites; and (3) management of cropland by management groups of soils.

MANAGEMENT PROBLEMS AND PRACTICES COMMON TO MOST SOILS

The management problems and practices common to most soils are those pertaining to soil fertility, erosion, and tillage.

SOIL FERTILITY

Some of the important problems dealing with soil fertility are the availability of plant nutrients in the soil, correcting soil acidity, and the use of animal manures and crop residues.

Plant nutrients.—Many of the soils of Saline County are deficient in phosphorus and nitrogen. The deficiency in phosphorus is most marked on soils derived from Dakota sandstone. It is least noticeable on fertile alluvial soils. Deficiencies in phosphorus can be corrected by adding phosphorus fertilizer and by using animal manures. The deficiency in nitrogen is most severe on eroded upland soils and on soils used continuously to grow small grains. Deficiencies in nitrogen are most apparent during seasons of above-average rainfall. In such seasons, nitrogen fertilizers can be added profitably. Pastures too, are more readily established where liberal applications of nitrogen have been made. The use of legumes in the crop rotation greatly reduces the need for commercial nitrogen fertilizers.

Soil acidity.—Acidity of soils interferes with the growth of many kinds of plants; and it affects the availability of plant nutrients, particularly phosphorus and some of the minor elements that are present in the soil. Some crops thrive on acid soils, but others require nearly neutral or alkaline soils. Legumes require a higher pH than most other crops. Soil acidity can be corrected by the addition of limestone or other liming material. In Saline County, soils derived from Dakota sandstone are acid in reaction.

Animal manures and crop residues.—Efforts should be made to conserve and use the manure produced on livestock farms. Manure adds organic matter to soils and improves their tilth. In addition, nitrogen stored in manure leaches less readily from the soils. Burning crop residues, stubble, or grass results in much loss of organic matter. Plant residues, like manure, act as a storehouse for plant nutrients. If they are returned to the soil, they improve tilth and, as they decay, release nutrients to growing plants.

Suggestions concerning the use of fertilizers, lime, and manure may be obtained from the county agricultural agent, a local representative of the Soil Conservation Service, or from the Kansas Agricultural Experiment Station.

SOIL EROSION

Erosion by water and wind is a problem in Saline County. Measures used to control water erosion in the county include construction of waterways and outlets, terraces (pl. 3, A), diversion terraces, and mechanical structures; contour tillage; and the utilization of crop residues. Measures taken to control wind erosion are stripcropping, growth of cover crops, utilization of plant residues, emergency tillage, and the planting of shelterbelts.

SOIL TILLAGE

Problems pertaining to soil tillage include time and amount of tillage, utilization of crop residues, formation of hardpans, and weed and volunteer growth on fallow land. Excessive tillage destroys soil structure and hastens loss of organic matter. Tilling soils that are too wet causes hardpans to form and produces hard clods that are difficult to work down to a suitable seedbed. Tillage pans can often be avoided by varying the depth of tillage. The structure of compact subsoils can often be improved by growing of deep-rooted crops; however, it may be necessary to encourage such growth by the application of lime and fertilizers. Tillage—other than that required in preparing the seedbed, planting, and cultivating—should be limited to the control of weeds and volunteer growth on fallow ground. Effective moisture storage cannot be accomplished on fallow land unless most weed and volunteer growth is prevented. The incorporation of plant residues in the plow layer increases the moisture-holding capacity and improves the tilth of the soil.

MANAGEMENT OF NATIVE PASTURE BY RANGE SITES[4]

Native pastures in Saline County are productive if properly managed. Generally, they are most productive when the vegetation is the same as that which originally grew on the land. This original vegetation is known as the climax vegetation, meaning that it is the best the climate will support. In this vegetation are plants having different characteristics and habits of growth. Some grow best in cool seasons, and others make their growth chiefly in warm weather. Some grow well in lowlands and on moist soils; others, less productive but better suited to drier sites, get along well on the upland loams and clays. Usually a pasture consisting of a combination of plants having somewhat different habits of growth is better than a pasture made up of any one plant alone. The kinds of plants that grow best on a site depend on the nature of the site. The way the plants on a particular site are managed or grazed influences the condition of the range.

RANGE SITE AND CONDITION

Range site refers to the soils in a given kind of geographic location and the local climate, drainage, water supply, and other environmental characteristics of that location. *Range condition* is arrived at by comparing the present vegetation with the original, or climax, vegetation. This comparison provides an indirect measure of past grazing management.

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[4] Prepared by C. M. SCHUMACHER, F. D. ABBOTT, and R. K. JACKSON, Soil Conservation Service.

Generally range sites produce the most when the vegetation is the same or nearly the same as the original cover. To help the manager determine the present condition of his rangeland or pastureland, four range condition classes are used. These classes, which are based on the relative abundance of dominant grasses in the present range cover as compared with their abundance in the original or native grassland, are: Excellent, 76 to 100 percent; good, 51 to 75 percent; fair, 26 to 50 percent; and poor, 0 to 25 percent.

Your local Soil Conservation Service representative can help you in learning about the different kinds of rangeland you have, the grasses it will produce, and the amount of grazing you can expect.

PRINCIPLES OF RANGE MANAGEMENT

Whatever the range site or the range condition, there are four principles which must be rigidly applied to achieve good range management: (1) Stocking the proper number of livestock; (2) proper distribution of grazing; (3) proper season of use; and (4) proper kinds of grazing animals.

Proper number of livestock.—The number of livestock on the range must be balanced against the time they will graze and the condition of the forage. If the balance is correct, the forage left on the ground will (1) protect the soil from wind and water erosion, (2) promote vigorous growth by storing moisture and food, and (3) allow grasses to crowd out weeds. Under these conditions the vegetation responds quickly following dry spells.

Table 6 suggests stocking rates for various range sites according to range condition. The rates are given in the approximate number of acres needed for grazing one cow during the 6-month grazing season. Rates indicated for good, fair, and poor range conditions are intended to permit pastures to regain excellent condition. Because of climatic variations, the range manager should adjust livestock numbers from season to season by watching the degree of range use. An accepted practice is to graze about half the growth and then move the animals to other pastures or provide supplemental feed.

TABLE 6.—*Suggested stocking rates for range sites by range condition classes*

Range site	Suggested stocking rates by range condition classes			
	Excellent	Good	Fair	Poor
	Acres per cow[1]	*Acres per cow*[1]	*Acres per cow*[1]	*Acres per cow*[1]
Lowland	5	7	10	20
Loamy upland	6	8	12	24
Sandy land	6	8	12	24
Clay upland	7	10	15	30
Shallow land	7	10	15	30
Breaks	7	10	15	30

[1] Acres needed to graze a cow for a 6-month period in a normal year.

Proper distribution of grazing.—One of the aims of good management is to obtain uniform use of rangeland or pastureland. Pastures are often overused in some parts and underused or not grazed at all in other parts. This problem usually can be overcome by proper distribution of salt and water and proper location of fences.

Proper season of use.—Pasture fences and time of grazing often can be arranged so that livestock will graze cool-season grasses early in spring or in fall and warm-season grasses in summer. The kinds and amounts of grass that each pasture will produce and the best time for grazing are determined by the range site and the condition of the grass cover. Pastures in good to excellent condition should have a short rest during the growing season to maintain their condition. Those in fair to poor condition should have longer periods of rest.

Proper kinds of grazing animals.—The animals grazed should suit the grass, soils, and climate of the area. In general, cattle make the best use of the tall grasses in Saline County.

DESCRIPTIONS OF RANGE SITES

LOWLAND

This site consists of soils on terraces and flood plains. They have loam to clay loam surface layers and silt loam to clay subsoils. Soils on this site receive additional moisture from higher areas and from stream overflow. They have moderate infiltration rates and high water-holding capacities.

The soils of this site are:

Alluvial land (Ad).
Arkansas fine sandy loam, 0 to 2 percent slopes (Ae).
Arkansas fine sandy loam, 2 to 6 percent slopes (Af).
Bonaccord silty clay loam, 0 to 2 percent slopes (Br).
Bonaccord silty clay loam, 2 to 6 percent slopes (Bs).
Bonaccord silty clay loam, 2 to 6 percent slopes, eroded (Bt).
Bonaccord silty clay loam-Solonetz complex, 0 to 2 percent slopes (Bu).
Detroit loamy very fine sand, overwash phase, 0 to 2 percent slopes (Da).
Detroit silt loam, 0 to 2 percent slopes (Db).
Detroit silt loam, 2 to 6 percent slopes (Dc).
Detroit silty clay loam, 0 to 2 percent slopes (Df).
Detroit silty clay loam, 2 to 6 percent slopes (Dg).
Detroit silty clay loam, 2 to 6 percent slopes, eroded (Dh).
Detroit silt loam, overwash phase, 0 to 2 percent slopes (Dd).
Detroit silt loam, overwash phase, 2 to 6 percent slopes (De).
Falun fine sandy loam, 0 to 2 percent slopes (Fa).
Falun fine sandy loam, 2 to 6 percent slopes (Fb).
Fore silty clay loam, deep over silt, 0 to 2 percent slopes (Fe).
Fore silty clay loam, deep over silt, 2 to 6 percent slopes (Ff).
Fore clay, 0 to 2 percent slopes (Fc).
Fore clay, 2 to 6 percent slopes (Fd).
Hobbs silt loam, 0 to 2 percent slopes (Hv).
Hobbs silt loam, 0 to 2 percent slopes, eroded (Hw).
Hobbs silt loam, 2 to 6 percent slopes (Hx).
Hobbs silt loam, 2 to 6 percent slopes, eroded (Hy).
Hobbs silt loam, light-colored variant, 0 to 2 percent slopes (Hz).
Humbarger loam, 0 to 2 percent slopes (Hza).
Humbarger loam, 2 to 6 percent slopes (Hzb).
Humbarger loam, 2 to 6 percent slopes, eroded (Hzc).
Humbarger silt loam, 0 to 2 percent slopes (Hzd).
Humbarger silt loam, 2 to 6 percent slopes (Hze).
Humbarger silt loam, 2 to 6 percent slopes, eroded (Hzf).

Humbarger silt loam, 2 to 6 percent slopes, severely eroded (Hzg).
Langley silt loam, 0 to 2 percent slopes (Ls).
Langley silt loam, 2 to 6 percent slopes (Lt).
Langley silty clay loam, 2 to 6 percent slopes, eroded (Lu).
Langley silt loam-Solonetz complex, 0 to 2 percent slopes (Lv).
Lindsborg silt loam, 0 to 2 percent slopes (Lzb).
Lockhard silt loam, 0 to 2 percent slopes (Lzd).
Lockhard silt loam, 0 to 2 percent slopes, eroded (Lze).
Lockhard silt loam, 2 to 6 percent slopes (Lzf).
Lockhard silt loam, 2 to 6 percent slopes, eroded (Lzg).
Lockhard silt loam, 2 to 6 percent slopes, severely eroded (Lzh).
Marydel silt loam, 0 to 2 percent slopes (Mg).
Marydel fine sandy loam, 0 to 2 percent slopes (Md).
Marydel loam, poorly drained variant, 0 to 2 percent slopes (Me).
Muir silt loam, 0 to 2 percent slopes (Mh).
Muir silt loam, 2 to 6 percent slopes (Mk).
New Cambria silty clay loam, 0 to 2 percent slopes (Na).
Rokeby silt loam, 0 to 2 percent slopes (Rd).
Roxbury silty clay loam, 0 to 2 percent slopes (Rf).
Roxbury silty clay loam, 2 to 6 percent slopes, eroded (Rg).
Salemsburg silt loam, 0 to 2 percent slopes (Sa).
Smoky Butte silt loam, 0 to 2 percent slopes (Sn).
Solomon clay, 0 to 2 percent slopes (Ss).
Solomon clay, low lime variant, 0 to 2 percent slopes (St).
Stimmel silt loam, 0 to 2 percent slopes (Su).
Stimmel silt loam, 2 to 6 percent slopes (Sv).
Stimmel silty clay loam, 2 to 6 percent slopes, severely eroded (Sw).
Sutphen silty clay, 0 to 2 percent slopes (Sx).
Tobin silt loam, 0 to 2 percent slopes (Tc).
Tobin silt loam, 2 to 6 percent slopes (Td).
Wabash silty clay loam, 0 to 2 percent slopes (Wa).
Windom fine sandy loam, 0 to 2 percent slopes (We).
Windom fine sandy loam, 2 to 6 percent slopes (Wf).
Windom loam, 0 to 2 percent slopes (Wg).
Windom loam, 2 to 6 percent slopes (Wh).

Vegetation.—Big bluestem is the dominant grass in the climax vegetation. Indiangrass, which is similar to big bluestem in moisture requirements, is present in smaller amounts. Prairie cordgrass, switchgrass, and wildrye grow where the soil moisture is most favorable. Other grasses that occur in lesser amounts are side-oats grama and tall dropseed. In addition to the above grasses, many forbs grow on this site. Among these are perennial sunflowers, compassplant, wholeleaf rosinweed, American licorice, and sageworts.

RANGE INDICATORS: Side-oats grama and tall dropseed are among the first grasses to increase as the range condition declines. If overgrazed, especially during droughts, short buffalograss and blue gramagrass invade the site. Other plants invading this site because of the favorable moisture supply are the coarse forbs, ironweed, wooly vervain, and snow-on-the-mountain.

PRODUCTION: Because of the favorable moisture supply, the soils on this site will produce more than the climax normal if the range is kept in excellent condition. Production, as measured by hay yields, ranges from 1 to 2 tons per acre annually.

LOAMY UPLAND

This site has deep and moderately deep soils that have loam to clay loam surface soils and subsoils. They occur on nearly level

to rolling uplands. They have moderate infiltration rates and high water-holding capacities. Root development is not restricted in these soils. The soils in this site are:

Albion loam, 2 to 6 percent slopes (Ab).
Albion loam, 6 to 12 percent slopes (Ac).
Elmo silt loam, 2 to 6 percent slopes (Ev).
Elmo silt loam, 6 to 12 percent slopes (Ew).
Elmo silty clay loam, 2 to 6 percent slopes, severely eroded (Ex).
Elmo silty clay loam, 6 to 12 percent slopes, severely eroded (Ey).
Elmo loam, terrace phase, 2 to 6 percent slopes (Er).
Elmo loam, terrace phase, 2 to 6 percent slopes, eroded (Es).
Elmo silt loam, terrace phase, 0 to 4 percent slopes (Et).
Elmo silt loam, terrace phase, 0 to 4 percent slopes, eroded (Eu).
Geary silt loam, 2 to 6 percent slopes (Ga).
Geary silt loam, 2 to 6 percent slopes, eroded (Gb).
Geary silt loam, 6 to 12 percent slopes (Gc).
Geary silt loam, 6 to 12 percent slopes, severely eroded (Gd).
Hall silt loam, 0 to 2 percent slopes (Ha).
Hall silt loam, 2 to 6 percent slopes (Hb).
Hall silt loam, 2 to 6 percent slopes, eroded (Hc).
Hall silt loam, brown subsoil variant, 0 to 2 percent slopes (Hd).
Hall silt loam, brown subsoil variant, 2 to 6 percent slopes (He).
Hallville loam, 2 to 6 percent slopes (Hf).
Hallville loam, 2 to 6 percent slopes, eroded (Hg).
Hallville loam, 6 to 12 percent slopes (Hh).
Hallville loam, 6 to 12 percent slopes, severely eroded (Hk).
Hallville loam, shallow phase, 2 to 6 percent slopes (Hl).
Hallville loam, shallow phase, 2 to 6 percent slopes, severely eroded (Hm).
Hallville loam, shallow phase, 6 to 12 percent slopes (Hn).
Hallville loam, shallow phase, 6 to 12 percent slopes, severely eroded (Ho).
Kipp silt loam, 2 to 6 percent slopes (Ka).
Kipp silt loam, 6 to 12 percent slopes (Kb).
Kipp silty clay loam, 2 to 6 percent slopes, eroded (Kc).
Kipp silty clay loam, 2 to 6 percent slopes, severely eroded (Kd).
Kipp silty clay loam, 6 to 12 percent slopes, severely eroded (Ke).
Lancaster loam, 2 to 6 percent slopes (Lh).
Lancaster loam, 2 to 6 percent slopes, eroded (Lk).
Lancaster loam, 2 to 6 percent slopes, severely eroded (Ll).
Lancaster loam, 6 to 12 percent slopes (Lo).
Lancaster loam, 6 to 12 percent slopes, severely eroded (Lp).
Lancaster loam, shallow phase, 2 to 6 percent slopes (Lm).
Lancaster loam, shallow phase, 2 to 6 percent slopes, eroded (Ln).
Lancaster loam, shallow phase, 6 to 12 percent slopes (Lr).
Ninnescah silt loam, 0 to 2 percent slopes (Nh).
Ninnescah silt loam, 2 to 6 percent slopes (Nk).
Shellabarger loam, 2 to 6 percent slopes (Se).
Shellabarger loam, 2 to 6 percent slopes, eroded (Sf).
Shellabarger loam, 2 to 6 percent slopes, severely eroded (Sg).
Shellabarger loam, 6 to 12 percent slopes, eroded (Sh).
Shellabarger silt loam, 0 to 2 percent slopes (Sk).
Shellabarger silt loam, 2 to 6 percent slopes (Sl).
Shellabarger silt loam, 2 to 6 percent slopes, eroded (Sm).
Westfall silt loam, 2 to 6 percent slopes (Wb).
Westfall silty clay loam, 2 to 6 percent slopes, eroded (Wc).
Westfall silty clay loam, 2 to 6 percent slopes, severely eroded (Wd).
Yordy loam, 2 to 6 percent slopes (Ya).
Yordy loam, 6 to 12 percent slopes (Yc).
Yordy silty clay loam, 2 to 6 percent slopes, eroded (Ye).
Yordy loam, shallow phase, 2 to 6 percent slopes (Yb).
Yordy loam, shallow phase, 6 to 12 percent slopes (Yd).
Yordy silty clay loam, shallow phase, 2 to 6 percent slopes, eroded (Yf).

Vegetation.—The climax vegetation on this site is prairie grasses of both the tall and mid types. Little bluestem is the dominant grass. Big bluestem increases in the stand near the foot of slopes and in other areas that receive more moisture. Bluestem grasses, together with Indiangrass, switchgrass, and side-oats grama, make up more than 85 percent of the climax cover. Also present are the following grasses, legumes, and forbs: Grasses—tall dropseed, purple lovegrass, blue grama, and rosette panicums; legumes—leadplant, scurf-pea, prairieclover, and wildindigo, sensitive plant; and forbs—pitcher's sage and compassplant.

RANGE INDICATORS: Side-oats grama, tall dropseed, and purple lovegrass usually are the first grasses to increase in number when the better grasses are overused. If overuse continues, the taller grasses are thinned out or are less vigorous in their growth. When the tall grasses thin out, the rainfall is lost as runoff and soon the short grasses—buffalograss, blue grama, and hairy grama—become dominant. Other plants that invade this site when the climax vegetation declines are ironweed, woolly vervain, western ragweed, tumblegrass, windmillgrass, and some annual grasses. Woody plants, such as smooth sumac, invade only those areas having adequate moisture for their growth.

PRODUCTION: Since the soils on this site receive little water from other soils and retain most of the water falling on them, production is closely associated with the amount of rainfall. In general, production is about average for the rainfall belt.

CLAY UPLAND

This site is made up of nearly level to rolling upland soils that have silt loam to silty clay loam surface soils and heavy clay subsoils. Water movement is restricted by the heavy subsoils. The water-holding capacity of these soils is high, but not all the moisture held is available to plants. The soils of this site are:

Assaria silt loam, 2 to 6 percent slopes (Ag).
Assaria silty clay loam, 2 to 6 percent slopes, eroded (Ah).
Benfield silty clay loam, 2 to 6 percent slopes (Bh).
Benfield silty clay loam, 2 to 6 percent slopes, eroded (Bb and Bk).
Benfield silty clay loam, 2 to 6 percent slopes, severely eroded (Bc and Bl).
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes (Bd).
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, eroded (Be).
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, severely eroded (Bf).
Benfield silty clay loam, shallow phase, 6 to 12 percent slopes, severely eroded (Bg).
Berg silt loam, 0 to 2 percent slopes (Bm).
Berg silt loam, 2 to 6 percent slopes (Bn).
Berg silty clay loam, 2 to 6 percent slopes, eroded (Bo).
Berg silty clay loam, 2 to 6 percent slopes, severely eroded (Bp).
Carlson silty clay loam, 2 to 6 percent slopes (Ca).
Carlson silty clay loam, 6 to 12 percent slopes (Cb).
Ebenezer silt loam, 0 to 2 percent slopes (Eb).
Ebenezer silt loam, 2 to 6 percent slopes (Ec).
Ebenezer silty clay loam, 0 to 2 percent slopes, eroded (Ef).
Ebenezer silty clay loam, 2 to 6 percent slopes, eroded (Eg).

Ebenezer silty clay loam, 2 to 6 percent slopes, severely eroded (Eh).
Ebenezer silty clay loam, 6 to 12 percent slopes, eroded (Ek).
Ebenezer loam, 2 to 6 percent slopes (Ea).
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes (Ed).
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes, eroded (Ee).
Edalgo silt loam, 2 to 6 percent slopes (E).
Edalgo silt loam, 2 to 6 percent slopes, eroded (Em).
Edalgo silt loam, 6 to 12 percent slopes (En).
Edalgo silt loam, 2 to 6 percent slopes, severely eroded (Eo).
Edalgo silt loam, 6 to 12 percent slopes, severely eroded (Ep).
Englund silt loam, 2 to 6 percent slopes (Ez).
Englund silt loam, 2 to 6 percent slopes, eroded (Eza).
Englund silt loam, 2 to 6 percent slopes, severely eroded (Ezb).
Idana silt loam, 2 to 6 percent slopes (Ia).
Idana silt loam, 2 to 6 percent slopes, eroded (Ib).
Idana silty clay loam, 2 to 6 percent slopes, severely eroded (Ic).
Idana silty clay loam, 6 to 12 percent slopes, eroded (Id).
Lanham silt loam, 2 to 6 percent slopes (Lw).
Lanham silt loam, 2 to 6 percent slopes, severely eroded (Lx).
Lanham silt loam, 6 to 12 percent slopes (Ly).
Longford silt loam, 0 to 2 percent slopes (Lzk).
Longford silt loam, 2 to 6 percent slopes (Lzl).
Longford silty clay loam, 2 to 6 percent slopes, eroded (Lzm).
Malmgren silt loam, 0 to 2 percent slopes (Mb).
Malmgren silt loam, 2 to 6 percent slopes (Mc).
McPherson silt loam, 0 to 3 percent slopes (Ma).
Niles silt loam, 0 to 2 percent slopes (Nb).
Niles silt loam, 2 to 6 percent slopes (Nc).
Niles silt loam, 2 to 6 percent slopes, severely eroded (Ng).
Niles silty clay loam, 0 to 2 percent slopes, eroded (Nd).
Niles silty clay loam, 2 to 6 percent slopes, eroded (Ne).
Niles silty clay loam, 2 to 6 percent slopes, severely eroded (Nf).
Rentide silt loam, 2 to 6 percent slopes (Ra).
Rentide silt loam, moderately shallow phase, 2 to 6 percent slopes (Rb).
Rentide silty clay loam, 2 to 6 percent slopes, eroded (Rc).
Smolan silt loam, 2 to 6 percent slopes (So).
Smolan silt loam, 2 to 6 percent slopes, eroded (Sp).
Smolan silt loam, 2 to 6 percent slopes, severely eroded (Sr).
Tescott silt loam, 2 to 6 percent slopes (Ta).
Tescott silty clay loam, 2 to 6 percent slopes, eroded (Tb).

Vegetation.—The climax vegetation on this somewhat droughty site is of the mixed-prairie type. The principal mid grasses are side-oats grama, western wheatgrass, tall dropseed, junegrass, and sand dropseed. Short grasses make up about 25 percent of the plant cover. Bluestem grasses are not abundant. They grow principally on those areas within the site that have the most moisture. The following forbs grow on this site: heath aster, scurf-pea, and goldenrod. Generally forbs are not so tall on this site as on the loamy upland site, and, therefore, they are less conspicuous.

RANGE INDICATORS: Where this site is heavily grazed, the cover consists almost entirely of short grasses, chiefly buffalograss and blue grama. When the moisture supply is favorable in fall and spring, annual brome, little barley, and other annual grasses may be abundant. Among other invading grasses are tumblegrass and windmillgrass.

PRODUCTIVITY: The soils on this site are less productive than those on the loamy upland range site.

SANDY LAND

In this site are the soils that have sandy loam and fine sandy loam surface soils and subsoils. They occur on undulating or low dunelike topography. They have high infiltration rates and moderate water-holding capacities. The soils of this site are:

Albion coarse sandy loam, shallow phase, 2 to 6 percent slopes (Aa).
Lancaster fine sandy loam, 2 to 6 percent slopes (La).
Lancaster fine sandy loam, 2 to 6 percent slopes, eroded (Lb).
Lancaster fine sandy loam, 2 to 6 percent slopes, severely eroded (Lc).
Lancaster fine sandy loam, 6 to 12 percent slopes (Lf).
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes (Ld).
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes, eroded (Le).
Lancaster fine sandy loam, shallow phase, 6 to 12 percent slopes (Lg).
Lincoln loamy fine sand, 0 to 2 percent slopes (Lz).
Lincoln loamy fine sand, 2 to 6 percent slopes (Lza).
Lockhard loamy fine sand, overblown phase, 2 to 6 percent slopes (Lzc).
Marydel loamy fine sand, 0 to 2 percent slopes (Mf).
Pratt fine sandy loam, 2 to 6 percent slopes (Pa).
Pratt fine sandy loam, 2 to 6 percent slopes, eroded (Pb).
Shellabarger fine sandy loam, 2 to 6 percent slopes (Sb).
Shellabarger fine sandy loam, 2 to 6 percent slopes, eroded (Sc).
Shellabarger fine sandy loam, 2 to 6 percent slopes, severely eroded (Sa).
Windom loamy fine sand, sandy substratum variant, 0 to 2 percent slopes (Wk).
Windom loamy fine sand, sandy substratum variant, 2 to 6 percent slopes (Wl).

Vegetation.—The climax plant cover is a mixture of tall grasses and mid grasses. Little bluestem is the dominant grass. Other grasses growing on this site are big bluestem, switchgrass, prairie junegrass, side-oats grama, fall witchgrass, and hairy grama. The following forbs usually are present: tephrosia, leadplant, roundhead lespedeza, sensitivebrier, pitcher's sage, goldenrod, and gayfeather.

RANGE INDICATORS: Side-oats grama, fall witchgrass, and hairy grama are among the first grasses to increase in the stand as range condition declines. Chickasaw plum is one of the principal woody invaders. Since most of the rainfall penetrates these soils, they are more likely to become weedy when overgrazed than to have the short-mowed appearance of range on overgrazed loamy upland. The principal weedy forbs are gumweed, broomweed, and goldenrod.

PRODUCTIVITY: These soils do not have so great a moisture-holding capacity as those of the loamy upland range site. More water penetrates, however, and consequently, when the range is in excellent condition, the soils will yield approximately the same amount of forage as soils on the loamy upland range site.

SHALLOW LAND

This site has loamy soils that are shallow over rock or other consolidated materials. Root growth and water storage are limited by the underlying materials. The soils of this site are:

Cloud silty clay loam, 2 to 6 percent slopes (Cc).
Cloud silty clay loam, 6 to 12 percent slopes (Cd).
Cloud silty clay loam, 6 to 12 percent slopes, severely eroded (Ce).
Englund silty clay loam, very shallow variant, 2 to 6 percent slopes (Ezc).

Kipson silt loam, 2 to 6 percent slopes (Kh).
Kipson silt loam, 6 to 12 percent slopes (Kk).
Kipson silt loam, over 12 percent slopes (Kl).
Kipson shaly silt loam, 2 to 6 percent slopes, eroded (Kf).
Kipson shaly silt loam, 6 to 12 percent slopes, severely eroded (Kg).
Vernon silty clay loam, 2 to 6 percent slopes (Va).
Vernon silty clay loam, 2 to 6 percent slopes, severely eroded (Vb).
Vernon silty clay loam, 6 to 12 percent slopes (Vc).

Vegetation.—The climax plant cover consists chiefly of the mid grasses, mainly side-oats grama, little bluestem, and tall dropseed. Fewer tall grasses are present than on the loamy uplands, but the short grass, hairy grama, is more abundant. Among the forbs growing on this range site are black-samson and perennial sunflowers and legumes such as leadplant, prairie-clover, and scurf-pea.

RANGE INDICATORS: Short grasses, such as hairy grama, are among the first to increase in the stand as range condition declines. Among the invading plants are tumblegrass, windmillgrass, western ragweed, and annual plants.

PRODUCTIVITY: This range site is less productive than the loamy upland range site.

BREAKS

In this site are loamy soils that overlie partially weathered Dakota sandstone and sandy shales. The soils are on rolling to steep slopes. Although the soils are generally shallow, the underlying material permits some moisture penetration and root development. The soils of this site are:

Hedville loam, 2 to 6 percent slopes (Hp).
Hedville loam, 2 to 6 percent slopes, eroded (Hr).
Hedville loam, 6 to 12 percent slopes (Hs).
Hedville stony loam, 2 to 6 percent slopes (Ht).
Hedville stony loam, 6 to 12 percent slopes (Hu).
Rough broken and rough stony land, Vernon and Hedville soil materials (Re).

Vegetation.—The climax plant cover is a mixture of tall grasses and mid grasses. Little bluestem is dominant. Side-oats grama and fall witchgrass are both more abundant on this site than on the loamy uplands. Other grasses are big bluestem, Indiangrass, switchgrass, purple lovegrass, and hairy grama. Among the forbs growing on this site are the following legumes: leadplant, roundhead lespedeza, and scurf-pea. Because of the rolling to steep slopes, this site is grazed less than the loamy upland range site and for that reason is often in a better condition.

RANGE INDICATORS: Side-oats grama and hairy grama are among the first grasses to increase in the stand when the condition of the range declines. The invading plants include western ragweed, tumblegrass, windmillgrass, and sometimes woody plants, such as coralberry.

PRODUCTIVITY: This site is similar to the loamy upland site in productivity, but cattle cannot graze the steep, rocky slopes as readily. Therefore, if the adjoining loamy upland pasture is to receive moderate use, this site will be lightly used.

RANGE PLANTS

The following list contains the scientific and common names of plants and grasses referred to in the range site descriptions. The scientific names of grasses are taken from MANUAL OF THE GRASSES OF THE UNITED STATES.[5] Names of plants other than grasses are taken from FLORA OF KANSAS.[6]

Perennial grasses

Tall grasses	
Andropogon gerardi	Big bluestem
Panicum virgatum	Switchgrass
Sorghastrum nutans	Indiangrass
Spartina pectinata	Prairie cordgrass
Tripsacum dactyloides	Eastern gramagrass
Mid grasses	
Agropyron smithii	Western wheatgrass
Andropogon scoparius	Little bluestem
Bouteloua curtipendula	Side-oats grama
Elymus spp.	Wildrye
Eragrostis spectabilis	Purple lovegrass
Koeleria cristata	Prairie junegrass
Leptoloma cognatum	Fall witchgrass
Sporobolus asper	Tall dropseed.
S. cryptandrus	Sand dropseed
Short grasses	
Bouteloua gracilis	Blue grama
B. hirsuta	Hairy grama
Buchloe dactyloides	Buffalograss
Chloris verticillata	Windmillgrass
Panicum spp.	Rosette panicum
Schedonnardus paniculatus	Tumblegrass

Annual grasses

Bromus spp.	Annual brome
Hordeum pusillum	Little barley

Legumes

Amorpha canescens	Leadplant
A. fruticosa	Indigobush amorpha
Baptisia spp.	Wildindigo
Glycyrrhiza lepidota	American licorice
Lespedeza capitata	Roundhead lespedeza
Petalostemon spp.	Prairieclover
Psoralea spp.	Scurf-pea
Schrankia uncinata	Sensitivebrier
Tephrosia sp.	Tephrosia

Other forbs

Ambrosia coronopifolia	Western ragweed
Amphiachyris dracunuloides	Broomweed
Artemisia spp.	Sage
Aster ericoides	Heath aster
Echinacea angustifolia	Blacksamson
Euphorbia marginata	Snow-on-the-mountain
Grindelia sp.	Gumweed
Helianthus spp.	Sunflowers

[5] HITCHCOCK, A. S. MANUAL OF THE GRASSES OF THE UNITED STATES. U. S. Dept. of Agr., Misc. Pub. No. 200, 1051 pp., illus. 1935 (revised by Agnes Chase, 1950).

[6] GATES, FRANK C. FLORA OF KANSAS. Kansas Agr. Expt. Sta., (Contribution No. 391 from the Dept. of Botany, Kansas State College): 266 pp., illus. 1940.

Liatris sp.	Gayfeather
Salvia pitcheri	Pitcher's sage
Silphium integrifolium	Wholeleaf rosinweed
S. laciniatum	Compassplant
Solidago spp.	Goldenrod
Verbena stricta	Woolly vervain
Veronia interior	Ironweed

Woody plants

Cephalanthus occidentalis	Buttonbush
Prunus angustifolia	Chickasaw plum
Rhus glabra	Smooth sumac
Symphoricarpos orbiculatus	Coralberry

MANAGEMENT OF CROPLAND BY MANAGEMENT GROUPS OF SOILS

The soils of Saline County have been placed in groups according to similar soil characteristics, relief, use, and management practices. These groups are identified by combined numerical and letter symbols. Soils placed in groups having the same numerical symbol have many soil characteristics and management practices in common. The letter symbols, when present, represent further subdivision based upon degree of slope and amount of erosion. Soils placed in subdivision A generally have gentle slopes and show little or only minor effects of erosion. Soils placed in subdivisions B, C, D, and E, respectively, occupy steeper slopes or are more eroded, or both.

Since soils placed in A subdivisions are not eroded or depleted as readily as soils placed in the B, C, or D subdivisions, they require less intense management practices to maintain their fertility and to protect them from erosion. Groups identified only by numerical symbols do not require further modification in their use or management because of slope or degree of erosion.

Group 1A.—This group consists of very shallow soils on 2 to 6 percent slopes. They rarely exceed 10 inches in thickness and are usually unproductive, difficult to till, and easily eroded when tilled. Some of them cannot be tilled. All are best used as permanent pasture and, when used for pasture, support a fair to good cover of native grasses. Runoff is excessive, and the soils require special management to control erosion. If managed properly, these soils may be tilled where they are associated with deeper and more productive soils. The soils in this group are:

Albion coarse sandy loam, shallow phase, 2 to 6 percent slopes.
Cloud silty clay loam, 2 to 6 percent slopes.
Cloud silty clay loam, 6 to 12 percent slopes.
Englund silty clay loam, very shallow variant, 2 to 6 percent slopes.
Hallville loam, 2 to 6 percent slopes.
Hallville loam, 6 to 12 percent slopes.
Hallville loam, shallow phase, 2 to 6 percent slopes.
Hallville loam, shallow phase, 6 to 12 percent slopes.
Hedville loam, 2 to 6 percent slopes.
Hedville loam, 6 to 12 percent slopes.
Hedville stony loam, 2 to 6 percent slopes.
Hedville stony loam, 6 to 12 percent slopes.
Kipson silt loam, 2 to 6 percent slopes.
Kipson silt loam, 6 to 12 percent slopes.
Kipson silt loam, over 12 percent slopes.
Vernon silty clay loam, 2 to 6 percent slopes.
Vernon silty clay loam, 6 to 12 percent slopes.

Group 1B.—Soils in this group are very shallow, eroded to severely eroded, and on 2 to 12 percent slopes. They occupy tilled areas, areas that were once tilled, and pastured areas where the sod has been destroyed. Erosion is proceeding rapidly. In most areas the surface layer has been removed and some gullying is present. Wherever possible these soils should be returned to permanent grass. The soils in this group are:

Cloud silty clay loam, 6 to 12 percent slopes, severely eroded.
Hallville loam, 2 to 6 percent slopes, eroded.
Hallville loam, 6 to 12 percent slopes, severely eroded.
Hallville loam, shallow phase, 2 to 6 percent slopes, severely eroded.
Hallville loam, shallow phase, 6 to 12 percent slopes, severely eroded.
Hedville loam, 2 to 6 percent slopes, eroded.
Kipson shaly silt loam, 2 to 6 percent slopes, eroded.
Kipson shaly silt loam, 6 to 12 percent slopes, severely eroded.
Vernon silty clay loam, 2 to 6 percent slopes, severely eroded.

Group 2A.—These are moderately deep, friable, slightly to moderately acid soils on 2 to 6 percent slopes. They are underlain by bedrock at depths of 20 to 36 inches. They are easily eroded by both water and wind and are low in available phosphorus. On eroded soils the surface layer is thinner and contains less organic matter and nitrogen.

The soils in this group are best used as permanent pasture, but they may be tilled if properly managed. When tilled, they are best suited to wheat and sorghum. Select crop rotations that build up and maintain fertility and that control erosion. Sweetclover is desirable in the rotation, but lime should be applied before planting. Manures and crop residues improve these soils. The soils in this group are:

Edalgo silt loam, 2 to 6 percent slopes.
Edalgo silt loam, 2 to 6 percent slopes, eroded.
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes.
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes, eroded.
Lancaster loam, shallow phase, 2 to 6 percent slopes.
Lancaster loam, shallow phase, 2 to 6 percent slopes, eroded.
Lanham silt loam, 2 to 6 percent slopes.

Group 2B.—These are moderately deep, friable, slightly to moderately acid soils on 2 to 12 percent slopes. They occupy ridge crests or border drainage channels in the uplands. Because of steep slopes or severe erosion, they are best suited to permanent pasture. Even when used as grassland, they require good range management to protect them from erosion. The soils in this group are:

Edalgo silt loam, 6 to 12 percent slopes.
Edalgo silt loam, 2 to 6 percent slopes, severely eroded.
Edalgo silt loam, 6 to 12 percent slopes, severely eroded.
Lancaster loam, shallow phase, 6 to 12 percent slopes.
Lancaster fine sandy loam, shallow phase, 6 to 12 percent slopes.
Lanham silt loam, 2 to 6 percent slopes, severely eroded.
Lanham silt loam, 6 to 12 percent slopes.

Group 3A.—This group consists of deep, friable, slightly to moderately acid upland soils on 2 to 6 percent slopes. They have developed in neutral to slightly alkaline parent materials weathered from interbedded shales and sandstones of the Dakota forma-

tion. Unweathered shale and sandstone beds underlie these materials at depths of 60 inches or more. The soils are moderate to low in fertility. Although moderately susceptible to erosion, they withstand moderate degrees of erosion without serious damage.

The soils in this group can be used either as cropland or permanent pasture. When tilled they are best suited to wheat and sorghums, but they require careful management to maintain fertility and to prevent erosion. Crops growing on these soils respond well to applications of phosphorus and nitrogen; and legumes also respond well to applications of lime. Management practices should include the incorporation of manures and plant residues whenever possible. The soils in this group are:

Lancaster loam, 2 to 6 percent slopes.
Lancaster loam, 2 to 6 percent slopes, eroded.
Lancaster fine sandy loam, 2 to 6 percent slopes.
Lancaster fine sandy loam, 2 to 6 percent slopes, eroded.
Westfall silt loam, 2 to 6 percent slopes.
Westfall silty clay loam, 2 to 6 percent slopes, eroded.

Group 3B.—These soils have developed from the same parent materials as the soils in group 3A. They generally occupy the steeper, narrow crests and shoulders of hills and ridges and the banks of drainage channels. Slopes range from 6 to 12 percent but are uneroded. Because of the steep slopes, these soils are best used as permanent grass. If tilled, they are best for wheat, legumes, or hay crops. The acreage tilled should be small and carefully managed. Row crops should be avoided. If they are used they should be tilled along the contour and managed to control erosion. These soils are low in phosphorus and require lime before they are seeded to legumes. Crop residue should be kept on the surface or incorporated in the surface layer. Proper management is essential to control runoff and assure sustained production of crops or forage. The soils in this group are:

Lancaster loam, 6 to 12 percent slopes.
Lancaster fine sandy loam, 6 to 12 percent slopes.

Group 3C.—This group consists of soils having the same parent materials as soils in group 3A. Like soils in preceding groups, they occur on 2 to 12 percent slopes, but they differ in being severely eroded. Their surface soil has been destroyed, and in many places most of the subsoil is gone. They are very low in fertility and are very susceptible to erosion. These soils are best used for permanent grass. If tilled, their susceptibility to erosion necessitates costly control measures that prevent economical use on slopes greater than 6 percent. Continued cultivation is possible in a few areas where slopes are less than 6 percent, but management practices must include the use of a suitable sequence of soil-building crops, use of supplemental fertilizers, and use of proper erosion control measures. The soils in this group are:

Lancaster loam, 2 to 6 percent slopes, severely eroded.
Lancaster loam, 6 to 12 percent slopes, severely eroded.
Lancaster fine sandy loam, 2 to 6 percent slopes, severely eroded.
Westfall silty clay loam, 2 to 6 percent slopes, severely eroded.

Group 4A.—The soils in this group are moderately deep to deep, slightly to moderately acid, upland soils on 2 to 6 percent slopes. They have fine-textured, compact subsoils and have developed in neutral to slightly alkaline parent materials. They are only moderately fertile and are very susceptible to erosion. Their fine-textured, compact subsoils restrict but do not entirely prohibit root growth. Consequently, any loss of friable surface soil is serious, as that is the part in which plant roots readily grow.

The soils in this group can be tilled, but require careful management to improve their fertility and prevent erosion. They are low in available phosphorus, but most crops growing on them respond to applications of phosphorus fertilizer. Legumes respond well to lime applied before planting. The soils in the group are:

Englund silt loam, 2 to 6 percent slopes.
Tescott silt loam, 2 to 6 percent slopes.

Group 4B.—These soils have the same slightly acid to moderately acid parent materials as the soils in group 4A. They differ in occurring on 2 to 6 percent slopes that are moderately eroded. Their present plow layer consists of the original surface soil mixed with the upper subsoil. Compared to soils in group 4A, they are less fertile, are more susceptible to erosion, and have thinner surface layers in which plant roots readily can grow.

The soils in this group are best used as permanent grassland; however, they may be tilled without serious damage if effective measures are taken to control erosion and to maintain soil fertility. These soils are usually too low in both available phosphorus and nitrogen for optimum yields. Most crops, however, respond to fertilizers that supply these elements. The soils in this group are:

Englund silt loam, 2 to 6 percent slopes, eroded.
Tescott silty clay loam, 2 to 6 percent slopes, eroded.

Group 4C.—This management group is best suited as permanent grassland. The soil in this group has the same slightly acid to moderately acid parent materials as soils in groups 4A and 4B. It also occurs on 2 to 6 percent slopes, but it differs in being severely eroded. The surface soil and most of the subsoil have been removed by erosion. The plow layer, therefore, is made up of the original fine-textured, very compact, subsoil. Consequently, the soil is difficult to till, relatively infertile, and very susceptible to erosion, particularly gullying. Control of runoff is difficult, as well as costly, in most areas. The only soil mapped in this group is:

Englund silt loam, 2 to 6 percent slopes, severely eroded.

Group 5A.—In this group are moderately deep, friable, slightly alkaline to calcareous upland soils. They are developing in calcareous residual parent materials that weathered from clay shales and interbedded limestones of the Wellington and Ninnescah formations.

Partially weathered or unweathered bedrocks underlie these soils at depths of 24 to 30 inches. Where the soils are eroded, the depth to weathered or unweathered bedrock is usually less

than 20 inches. In eroded areas, the soils are less fertile and more susceptible to erosion.

The soils in this group are best used as permanent grassland, although with proper management they may be tilled without damage. If tilled, they are best suited to small grains planted on the contour. Because of their shallow depth, these soils are severely damaged by only moderate erosion and their moisture-holding capacity is not sufficient to carry crops through the hot, dry months late in summer. Most of the soils are low in available phosphorus and, if eroded, in available nitrogen. Kipp soils are an exception. They generally have adequate supplies of phosphorus. Recommended management practices include control of runoff and the incorporation of manures and plant residues in the plow layer.

With the exception of one mapping unit, the soils in this group occur on 2 to 6 percent slopes. One mapping unit occurs on 6 to 12 percent slopes that are uneroded. The soils in this group are:

Benfield silty clay loam, shallow phase, 2 to 6 percent slopes.
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, eroded.
Kipp silt loam, 2 to 6 percent slopes.
Kipp silt loam, 6 to 12 percent slopes.
Kipp silty clay loam, 2 to 6 percent slopes, eroded.
Rentide silt loam, moderately shallow phase, 2 to 6 percent slopes.

Group 5B.—This group is made up of slightly alkaline to calcareous soils on 2 to 12 percent slopes. They differ from soils in group 5A mainly in being severely eroded. All of the surface soil and usually much of the subsoil have been removed. The remaining soil materials do not exceed 12 to 14 inches in thickness. Consequently, the soils in this group have lost most of their fertility and are very susceptible to erosion.

The soils in this group are best used as permanent grassland. Tillage is practicable in only a very few areas and then only if adequate measures are taken to control erosion. The following soils are in this group:

Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, severely eroded.
Benfield silty clay loam, shallow phase, 6 to 12 percent slopes, severely eroded.
Kipp silty clay loam, 2 to 6 percent slopes, severely eroded.
Kipp silty clay loam, 6 to 12 percent slopes, severely eroded.

Group 6A.—These deep, neutral to slightly alkaline, upland soils occur on 0 to 6 percent slopes. They have heavy clay subsoils that tend to restrict root growth. Consequently, any loss of friable surface soil further reduces the thickness of the layer in which plant roots can grow readily.

The soils in this group are used both as cropland and as permanent pasture, but if tilled, they require careful management to protect them from erosion and depletion. They are best suited to early maturing small grains and to shallow-rooted, drought-resistant crops that do not require large amounts of moisture late in summer. A cropping sequence should be used that will protect these soils from erosion, maintain their fertility, and improve their tilth. Good practices are incorporation of crop residues,

use of phosphorus fertilizer, and application of nitrogen fertilizer where needed. The soils in this group are:

Assaria silt loam, 2 to 6 percent slopes.
Idana silt loam, 2 to 6 percent slopes.
Malmgren silt loam, 0 to 2 percent slopes.
Malmgren silt loam, 2 to 6 percent slopes.
Rentide silt loam, 2 to 6 percent slopes.

Group 6B.—These deep, neutral to slightly alkaline upland soils occur on slopes of 2 to 12 percent. They differ from soils in group 6A in having lost most of their original topsoil. As a result, the thickness of the friable layer above the fine-textured compact subsoil has been greatly reduced. The present plow layer is a mixture of original surface soil and upper subsoil. Management practices that will protect the remaining surface soil are needed and also practices designed to break up the claypan layers and make them more friable. Continued erosion will further reduce the natural productivity of these soils and make them more difficult to manage.

These soils are used for pasture and crops. Although damaged by erosion, they are capable of sustained production under continuous cropping, if properly managed. They are best suited to wheat and sorghum. Crop sequences that include deep-rooted legumes are effective in breaking up the compact subsoils, even though the soils are not well suited to growing legumes.

Since these soils have lost much of their fertile surface layer, the need for phosphorus and nitrogen fertilizers is greater than on soils of group 6A. The need for plant residues in the surface layers is also great. One eroded soil with 6 to 12 percent slopes is included with this group. Areas of this soil are still capable of being tilled, but careful management is required to protect them from erosion. Areas of this soil in the upper end of this slope range should be retired to permanent pasture. The soils in this group are:

Assaria silty clay loam, 2 to 6 percent slopes, eroded.
Idana silt loam, 2 to 6 percent slopes, eroded.
Idana silty clay loam, 6 to 12 percent slopes, eroded.
Rentide silty clay loam, 2 to 6 percent slopes, eroded.

Group 6C.—This group contains a deep, neutral to slightly alkaline upland soil on 2 to 6 percent slopes that has been severely eroded. The surface soil has been removed, and usually a large part of the subsoil. The fine-textured subsoil layers generally extend into the plow layer. Much of the natural fertility has been lost. The soil is very difficult to till and very susceptible to continued erosion. Tilled areas should be regrassed and used as permanent pasture. The soil mapped is:

Idana silty clay loam, 2 to 6 percent slopes, severely eroded.

Group 7A.—These deep, slightly acid to slightly alkaline upland soils occur on 0 to 2 percent slopes. They are developing on deposits of calcareous loess that are usually more than 60 inches thick. The fine-textured compact subsoil, however, limits to 18 or 20 inches the depth of friable material in which plant roots

can grow readily. Erosion has increased the need for management in some areas but has not seriously altered the character of the soils.

The soils in this group are used both as cropland and grassland. Various crops can be grown, but the soils are best suited to wheat and sorghum. They are generally low in available phosphorus and nitrogen. The Lockhard soil is less responsive to phosphorus fertilizer than the Ebenezer soils. Application of fertilizers, manures, and plant residues will build up fertility, improve the tilth, and protect the soils from erosion. The soils in this group are:

Ebenezer silt loam, 0 to 2 percent slopes.
Ebenezer silty clay loam, 0 to 2 percent slopes, eroded.
Lockhard silt loam, 0 to 2 percent slopes.
Lockhard silt loam, 0 to 2 percent slopes, eroded.

Group 7B.—In this group are deep, slightly acid to slightly alkaline soils on 2 to 12 percent slopes. Some of the soils show moderate erosion. Of the uneroded soils, Lockhard silt loam, 2 to 6 percent slopes, is particularly susceptible to erosion. It occurs as long narrow bodies along drainage channels and is difficult to manage because of its location. Where eroded soils occur, the friable layer in which roots grow readily is usually not more than 14 inches thick.

The soils in this group are used for cropland and as permanent pasture. They are similar to soils in group 7A in management requirements, but require greater protection against water erosion. Lockhard silt loam, 2 to 6 percent slopes, is best used as permanent grassland. The soils in this group are:

Ebenezer loam, 2 to 6 percent slopes.
Ebenezer silt loam, 2 to 6 percent slopes.
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes.
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes, eroded.
Ebenezer silty clay loam, 2 to 6 percent slopes, eroded.
Ebenezer silty clay loam, 6 to 12 percent slopes, eroded.
Lockhard silt loam, 2 to 6 percent slopes.
Lockhard silt loam, 2 to 6 percent slopes, eroded.
Lockhard loamy fine sand, overblown phase, 2 to 6 percent slopes.

Group 7C.—In this group are deep, slightly acid to slightly alkaline upland soils on severely eroded slopes of 2 to 6 percent. The surface soil, and usually much of the subsoil, has been removed. The plow layer is made up almost entirely of the fine-textured compact subsoil. Most areas are unproductive, difficult to till, and very susceptible to more erosion.

The soils in this group are best used as permanent grassland. If tilled, they must be managed carefully to control erosion and to improve their tilth. Fertilizers are needed to replace the plant nutrients lost through erosion. The soils in this group are:

Ebenezer silty clay loam, 2 to 6 percent slopes, severely eroded.
Lockhard silt loam, 2 to 6 percent slopes, severely eroded.

Group 8A.—In this group are deep, dark-colored soils of the terraces and uplands. Slopes range from 0 to 3 percent. The subsoil is fine-textured and compact. The parent material gener-

ally is more than 6 feet thick and consists of calcareous, medium textured to moderately fine textured loess or alluvium. Erosion is not critical, but practices are needed that protect the soils from wind erosion. In areas where runoff water accumulates, the need for erosion control is greatest. Niles silty clay loam, 0 to 2 percent slopes, eroded, generally has less than 18 inches of friable soil material.

The soils in this group can be used as cropland or as permanent pasture. If tilled, they are best suited to wheat and sorghums. Crops on these soils respond well to phosphorus and nitrogen fertilizers. Manures and plant residues are needed to build up the fertility and improve the tilth of the soils. The soils in this group are:

Bonaccord silty clay loam, 0 to 2 percent slopes.
McPherson silt loam, 0 to 3 percent slopes.
Niles silt loam, 0 to 2 percent slopes.
Niles silty clay loam, 0 to 2 percent slopes, eroded.
Rokeby silt loam, 0 to 2 percent slopes.
Stimmel silt loam, 0 to 2 percent slopes.

Group 8B.—In this group are deep, dark-colored soils of the terraces and uplands. Slopes range from 2 to 6 percent, and some of the soils show moderate erosion.

The soils in this group can be used for crops or permanent pasture. If used for crops, they should be tilled on the contour. Crops on these soils need additional phosphorus and nitrogen. Other practices should be applied to build up soil fertility, control erosion, and improve tilth. Areas that are difficult to till and manage effectively, such as streambanks and the concave heads of drainageways, should be returned to permanent grassland. The soils in this group are:

Bonaccord silty clay loam, 2 to 6 percent slopes.
Bonaccord silty clay loam, 2 to 6 percent slopes, eroded.
Niles silt loam, 2 to 6 percent slopes.
Niles silty clay loam, 2 to 6 percent slopes, eroded.
Stimmel silt loam, 2 to 6 percent slopes.

Group 8C.—These deep, dark-colored soils of the terraces and uplands occupy slopes of 2 to 6 percent and are severely eroded. The original surface soil and much of the subsoil have been removed. The present plow layer consists of a mixture of the fine-textured, coarsely granular upper subsoil with the fine-textured, relatively coarse lower subsoil. The soils have lost much of their natural fertility and are very susceptible to continued erosion.

The soils in this group are best used as permanent grassland. If tilled, erosion control is very important. Since these soils occur mainly in narrow, irregular bodies along drainageways or at the heads of drainageways, erosion control is both difficult and costly. The soils in this group are:

Niles silt loam, 2 to 6 percent slopes, severely eroded.
Niles silty clay loam, 2 to 6 percent slopes, severely eroded.
Stimmel silty clay loam, 2 to 6 percent slopes, severely eroded.

Group 9A.—In this group are deep, slightly acid to slightly alkaline upland soils on 0 to 2 percent slopes. They have fine textured to moderately fine textured, moderately friable subsoil and have developed in deposits of calcareous loess or valley fill or in mixtures of these materials.

The soils can be used either as cropland or as permanent pasture. When tilled, they are best suited to wheat and sorghum, although various crops can be grown. Management should include protection from wind erosion and the use of deep-rooted legumes in the cropping sequence. The application of phosphorus fertilizer may be profitable. The soils in this group are:

Berg silt loam, 0 to 2 percent slopes.
Longford silt loam, 0 to 2 percent slopes.

Group 9B.—The soils of this group are deep and slightly acid to slightly alkaline. They occupy slopes of 2 to 6 percent on the uplands. Some of the soils show moderate erosion. The subsoil and parent material for these soils are similar to those described for soils of group 9A.

The soils in this group can be used either as cropland or permanent grassland. Because these soils have steeper slopes or are moderately eroded, they require greater protection from both wind and water than the soils in group 9A. Clean-tilled crops should be grown less frequently and tilled on the contour. Other desirable practices are use of phosphorus and nitrogen fertilizers, application of manures and plant residues, and the use of deep-rooted legumes in the cropping sequence. The soils in this group are:

Benfield silty clay loam, 2 to 6 percent slopes.
Benfield silty clay loam, 2 to 6 percent slopes, eroded.
Berg silt loam, 2 to 6 percent slopes.
Berg silty clay loam, 2 to 6 percent slopes, eroded.
Carlson silty clay loam, 2 to 6 percent slopes.
Longford silt loam, 2 to 6 percent slopes.
Longford silty clay loam, 2 to 6 percent slopes, eroded.
Smolan silt loam, 2 to 6 percent slopes.
Smolan silt loam, 2 to 6 percent slopes, eroded.

Group 9C.—In this group are deep, slightly acid to slightly alkaline soils of the upland. They occupy 2 to 6 percent slopes and are severely eroded. They have lost all of their surface soil and much of their upper subsoil. Consequently, they have lost much of their natural fertility and are very susceptible to continued erosion. They often occur as small, irregular bodies that are difficult to manage.

The soils in this group are best used as permanent grassland. Although continued cultivation may be possible in some places, the soils will require adequate protection from erosion and very careful management. Management practices should include the use of phosphorus and nitrogen fertilizers and manures. The soils in this group are:

Benfield silty clay loam, 2 to 6 percent slopes, severely eroded.
Berg silty clay loam, 2 to 6 percent slopes, severely eroded.
Smolan silt loam, 2 to 6 percent slopes, severely eroded.

Group 9D.—This group has a deep, slightly acid to slightly alkaline soil on 6 to 12 percent slopes. The soil is used as permanent grassland, and it is best to use it for that purpose and to protect it from erosion. The soil is:

Carlson silty clay loam, 6 to 12 percent slopes.

Group 10A.—This group is made up of deep, slightly acid to slightly alkaline, friable upland soils on 0 to 2 percent slopes. They have developed in moderately alkaline to calcareous loess or valley fill. Because they are friable, they are moderately susceptible to wind erosion. These soils are susceptible to gullying in positions where runoff accumulates.

These soils can be used as cropland or as permanent grassland. When tilled, they are best suited to small grains, but many kinds of crops can be grown. A cropping sequence should be used that will protect the soils from erosion and maintain fertility. The use of a legume crop in this sequence is desirable. The use of phosphorus fertilizer is advisable, particularly on Ninnescah silt loam, which is generally low in available phosphorus. The soils in this group are:

Ninnescah silt loam, 0 to 2 percent slopes.
Shellabarger silt loam, 0 to 2 percent slopes.

Group 10B.—In this group are deep, slightly acid to slightly alkaline friable soils of the uplands and terraces. Slopes range from 0 to 6 percent. Some of the soils are moderately eroded. Where eroded, the soils have lower natural fertility and are more susceptible to erosion.

The soils in this group may be used either as cropland or as permanent grassland. If tilled, they are best suited to small grains. The cropping sequence ought to include alfalfa and sweetclover. Clean-tilled crops should be grown infrequently. Careful management is needed to protect the soils from wind and water erosion and to maintain their fertility. The soils are generally low in available phosphorus and nitrogen. Plowing under of manures and crop residues and contour tillage are desirable. Tillage that leaves the soils loose and powdery should be avoided. Areas difficult to manage are best used as permanent grassland. The soils in this group are:

Elmo silt loam, 2 to 6 percent slopes.
Elmo silt loam, terrace phase, 0 to 4 percent slopes.
Elmo silt loam, terrace phase, 0 to 4 percent slopes, eroded.
Elmo loam, terrace phase, 2 to 6 percent slopes.
Elmo loam, terrace phase, 2 to 6 percent slopes, eroded.
Geary silt loam, 2 to 6 percent slopes.
Geary silt loam, 2 to 6 percent slopes, eroded.
Ninnescah silt loam, 2 to 6 percent slopes.
Shellabarger silt loam, 2 to 6 percent slopes.
Shellabarger silt loam, 2 to 6 percent slopes, eroded.
Shellabarger loam, 2 to 6 percent slopes.
Shellabarger loam, 2 to 6 percent slopes, eroded.
Shellabarger fine sandy loam, 2 to 6 percent slopes.
Shellabarger fine sandy loam, 2 to 6 percent slopes, eroded.

Group 10C.—These deep, friable, slightly acid to slightly alkaline soils occur on 2 to 6 percent slopes that are severely eroded. They have lost their original topsoil, and in many places much of their upper subsoil.

Because the soils of this group are deep and friable, they will withstand continued cultivation if they are protected from erosion and their fertility is maintained. Where such management is not possible, the soils should be returned to permanent grass. Although they are suited to many crops, only a well-planned cropping sequence that includes a legume should be used. The need for supplemental fertilizers, manures, and plant residues is greater on these soils than on the soils of group 10B. Any additional erosion will make these soils unsuitable for cropping and will decrease their value as grassland. The soils in this group are:

Elmo silty clay loam, 2 to 6 percent slopes, severely eroded.
Shellabarger loam, 2 to 6 percent slopes, severely eroded.
Shellabarger fine sandy loam, 2 to 6 percent slopes, severely eroded.

Group 10D.—These deep, friable, slightly acid to slightly alkaline soils occur on slopes of 6 to 12 percent. They show only minor erosion, but because of their steep slopes, are very susceptible to sheet erosion and gullying.

The soils are best used as permanent grassland. Limited areas, however, may be tilled if protected from erosion. A cropping sequence that includes a legume is desirable. Clean-tilled crops should not be grown. The soils in this group are:

Elmo silt loam, 6 to 12 percent slopes.
Geary silt loam, 6 to 12 percent slopes.

Group 10E.—These deep, friable, slightly acid to slightly alkaline soils occur on 6 to 12 percent slopes that are severely eroded. In most areas all of the surface soil and usually much of the subsoil have been removed by erosion.

The soils in this group are best used as permanent grassland. Cultivated areas should be returned to grassland as soon as possible. The soils in this group are:

Elmo silty clay loam, 6 to 12 percent slopes, severely eroded.
Geary silt loam, 6 to 12 percent slopes, severely eroded.
Shellabarger loam, 6 to 12 percent slopes, eroded.

Group 11A.—In this group are deep to moderately deep upland soils that are developing on friable loess deposits or valley fill. They overlie beds of coarse-textured Cretaceous channery material and outwash and are 18 to 60 inches deep. Consequently, they are excessively drained and tend to be droughty in the latter part of the growing season. The soils of this group occupy 2 to 6 percent slopes and in some areas show moderate erosion. Where eroded, they are less fertile and have surface layers that are thinner and more susceptible to erosion.

The soils in this group are best used as permanent grassland, but they may be tilled if they are carefully managed. Clean-tilled crops should be kept at a minimum. A cropping sequence is needed that protects the soils from wind and water erosion and includes a legume crop. Management practices should include the use of phosphorus and nitrogen fertilizers, manures, and plant residues. The soils in this group are:

Yordy loam, 2 to 6 percent slopes.
Yordy loam, shallow phase, 2 to 6 percent slopes.
Yordy silty clay loam, 2 to 6 percent slopes, eroded.
Yordy silty clay loam, shallow phase, 2 to 6 percent slopes, eroded.

Group 11B.—The soils of this group are deep to moderately deep and friable and have slopes of 6 to 12 percent. They generally occur on narrow ridge crests, on the shoulders of low hills, or along entrenched drainage channels. They are uneroded, but their irregular shapes and steep slopes make their management difficult and costly.

The soils in this group are best used as permanent grassland. Areas that are cultivated should be retired to permanent grassland. The soils in this group are:

Yordy loam, 6 to 12 percent slopes.
Yordy loam, shallow phase, 6 to 12 percent slopes.

Group 12.—The soils in this group are deep, sandy, and moderately acid to neutral soils. They occur on upland slopes of 2 to 6 percent and are moderately eroded in some areas. The parent materials consist of thick deposits of windblown sands. The soils in this group generally are too low in available phosphorus and nitrogen for optimum crop yields, and their friable surface layers are very susceptible to wind erosion.

The soils can be used either as cropland or as permanent grassland. When tilled, they are best suited to sorghum, but wheat and legumes are often grown. A cropping sequence should be selected that provides the best surface cover during the season of strongest winds. The use of crop residue and of phosphorus and nitrogen fertilizers is important. The soils in this group are:

Pratt fine sandy loam, 2 to 6 percent slopes.
Pratt fine sandy loam, 2 to 6 percent slopes, eroded.

Group 13A.—In this group are deep, dark-colored, neutral to alkaline soils on slopes of 0 to 2 percent. They occupy the drainageways in the uplands. They are developing on accumulations of alluvial-colluvial material and show very little soil development. The drainageways lead back into the uplands away from the major stream channels. Soil bodies along the drainageways generally are very narrow, are very uneven in slope, and are cut by meanders of the stream channels. The soils are highly productive but are subject to almost yearly overflow. The Falun soils are predominantly sandy. The Hobbs soils are predominantly medium textured or moderately fine textured.

This group consists of both uneroded soils and soils that have moderate erosion. Since the soils are not maturely developed, the separation of uneroded and eroded soils is not so important to their use or management as it would be on soils that are maturely developed. The separation is probably more important as an indication of erosion activity than of actual damage caused by erosion. In eroded areas part of the somewhat darker colored surface soil has been removed. The remaining surface soil is thinner and, if plowed, is mixed with lighter colored, underlying parent materials.

The soils in this group may be used either as cropland or as permanent grassland. Their use is determined more by the shape and location of the area than by the character of the soil. Areas that are narrow and hard to till and areas which cannot be ade-

quately protected from overflow are best used as permanent grassland. Areas that can be tilled are suited to all crops common in the county. The soils are not deficient in any of the essential plant nutrients, but they may require protection from overflow to prevent crop damage. The soils in this group are:

Falun fine sandy loam, 0 to 2 percent slopes.
Hobbs silt loam, 0 to 2 percent slopes.
Hobbs silt loam, 0 to 2 percent slopes, eroded.
Hobbs silt loam, light-colored variant, 0 to 2 percent slopes.

Group 13B.—The soils in this group differ from those in group 13A in occurring on slopes of 2 to 6 percent that are uneroded or moderately eroded. They usually occupy the very narrow upland drainage channels and in these positions are very difficult to till and manage. For this reason, they are best used as permanent grassland. The soils in this group are:

Falun fine sandy loam, 2 to 6 percent slopes.
Hobbs silt loam, 2 to 6 percent slopes.
Hobbs silt loam, 2 to 6 percent slopes, eroded.

Group 14A.—In this group are deep, dark-colored, well to moderately well drained soils on terraces and bottom lands. They occur on the nearly level to somewhat concave parts of broad terraces (0 to 2 percent slopes). Surface drainage in these areas is slow, and internal permeability is moderately slow.

The soils in this group may be used either as cropland or as permanent grassland. When tilled, they are suited to most of the crops grown in the area; however, crops that are tolerant of poor soil aeration for short periods grow best. Management practices that provide adequate surface drainage will improve tilth and prevent crop loss. Protection from wind erosion is also needed. A cropping sequence that includes a legume crop is desirable. Although the soils generally are not deficient in plant nutrients, nitrogen deficiencies may exist for short periods during the cold wet months in spring. Nitrogen, applied as a top dressing at this time, will provide greater initial growth of crops. The soils in this group are:

Detroit silty clay loam, 0 to 2 percent slopes.
New Cambria silty clay loam, 0 to 2 percent slopes.
Roxbury silty clay loam, 0 to 2 percent slopes.

Group 14B.—The soils in this group are deep, dark colored, and well drained to moderately well drained. They occupy slopes of 2 to 6 percent on terraces and bottom lands and are uneroded or moderately eroded. They generally occupy the banks and channels of shallow drainage courses or the oxbow remnants of old stream courses. Because of the narrow, elongated shape of the soil areas, management is often difficult. As a matter of convenience, the soils are often tilled across the narrow axis of the area, or up and down the slope. Some areas are moderately eroded. Shallow gullying usually accompanies the erosion.

The soils in this group are best used as permanent grassland. Tilled areas should be planted to grass and used as pasture or natural waterways. The soils in this group are:

Detroit silty clay loam, 2 to 6 percent slopes.
Detroit silty clay loam, 2 to 6 percent slopes, eroded.
Roxbury silty clay loam, 2 to 6 percent slopes, eroded.

Group 15.—The soils in this group are deep, dark colored, fine textured, and imperfectly drained. They occupy the nearly level to slightly concave areas on broad terrace flats. Slopes range from 0 to 2 percent. The soils are sometimes ponded for short periods following heavy rains. Since the internal drainage is slow, crops may be damaged by poor aeration during wet seasons.

The soils in this group may be used either as cropland or as permanent grassland. They are suited to most crops grown in the county, but crops may be damaged by flooding or their growth may be retarded by poor soil aeration during wet periods. Adequate surface drainage therefore is very important in management. The inclusion of legume crops in the cropping sequence is suggested. The soils usually are not deficient in plant nutrients, but topdressings of nitrogen fertilizers in the cold, wet spring months will encourage early growth of crops. The management or plant residue also is very important. If stubble is turned under before seeding, decay organisms on the residue compete with the growing plants for the available nitrogen. The timeliness of tillage and the application of nitrogen fertilizer can reduce such competition. The soils in this group are:

Sutphen silty clay, 0 to 2 percent slopes.
Wabash silty clay loam, 0 to 2 percent slopes.

Group 16.—The soils in this group are deep, dark colored, poorly drained, and fine textured. They are alluvial soils on slopes of 0 to 2 percent in the nearly level to gently concave broad terrace flats. Internal drainage is slow, and high water tables usually are present. Consequently, these soils are often ponded for short periods each year.

The soils in this group may be used as cropland if adequate drainage is provided, or as permanent grassland. With adequate surface drainage, most crops common to the area can be grown. These soils are usually adequately supplied with plant nutrients. Temporary deficiencies in nitrogen may develop during the cold, wet spring months, particularly if stubble is turned under before seeding. Decay organisms on the stubble compete with the growing plants for nitrogen. Timeliness of tillage and the application of nitrogen fertilizer reduce this competition. The soils in this group are:

Solomon clay, 0 to 2 percent slopes.
Solomon clay, low lime variant, 0 to 2 percent slopes.

Group 17A.—In this group are very poorly drained soils of the terraces and uplands. They occupy slopes of 0 to 2 percent in depressions that are frequently ponded. The Fore soil member of this group is an alluvial soil developing in fine-textured alluvial materials on terraces. It occurs in abandoned oxbow remnants and poorly drained drainage channels and shows little or no profile development. The Lindsborg member is a strongly developed Planosol that occurs in upland depressions. It has distinct A

horizons and a heavy-textured claypan subsoil. Although these soils differ morphologically, they are placed in the same management group because they lack adequate drainage.

The soils in this group are best used as permanent grassland. They may be tilled if adequate surface drainage is provided, but even then they are not very productive. If they are tilled, crops that can withstand poor soil aeration and ponding should be grown. In closed depressions, an outlet channel must be constructed before drainage is possible. Surface ditches and bedding should then be provided. Very often the cost of draining these soils is greater than the value of the reclaimed land. The soils in this group are:

Fore clay, 0 to 2 percent slopes.
Lindsborg silt loam, 0 to 2 percent slopes.

Group 17B.—The soil in this group is on very poorly drained terraces. Generally it occurs along the sides and on the bottoms of oxbow remnants or incipient drainage channels.

The soil is best used as permanent grassland. Drainage usually is less critical than on the soils of group 17A; however, these areas are subject to flooding. In addition they usually occur as narrow, irregular-shaped bodies that are difficult to till and manage. In some areas both rill and shallow gully erosion are a problem. Such areas should be returned to grassland. This group contains one mapping unit:

Fore clay, 2 to 6 percent slopes.

Group 18A.—In this group are deep, friable, well-drained soils of flood plains and terraces. Slopes range from 0 to 2 percent. The soils are medium textured to moderately fine textured and neutral to calcareous. They are not readily damaged by water erosion, but they are susceptible to wind erosion if unprotected. These are among the most productive soils in the county. With the exception of Windom fine sandy loam, 0 to 2 percent slopes, they are adequately supplied with all the essential plant nutrients.

The soils in this group may be used either as cropland or as permanent grassland. They are suited to all crops grown in the county. On all the soils, most crops respond to applications of phosphorus fertilizer. Management should be designed to maintain fertility and to protect the soils from wind erosion. The use of legumes in the cropping sequence and the incorporation of plant residues are both important to continued fertility. Since these soils are particularly susceptible to wind erosion in the spring, the plant cover should be managed to provide the greatest protection at this time. Excess pulverization of surface soils during tillage should be avoided. If the surface cover is not adequate to protect the soils, emergency tillage should be employed as soon as erosion is evident. Burning of stubble is undesirable because it is needed to check wind erosion. The soils in this group are:

Detroit silt loam, 0 to 2 percent slopes.
Fore silty clay loam, deep over silt, 0 to 2 percent slopes.
Hall silt loam, 0 to 2 percent slopes.

Hall silt loam, brown subsoil variant, 0 to 2 percent slopes.
Humbarger silt loam, 0 to 2 percent slopes.
Langley silt loam, 0 to 2 percent slopes.
Muir silt loam, 0 to 2 percent slopes.
Windom loam, 0 to 2 percent slopes.
Windom fine sandy loam, 0 to 2 percent slopes.

Group 18B.—In this group are deep, friable, well-drained soils on flood plains and terraces. They generally occur on slopes of 2 to 6 percent in narrow, elongated areas on the banks and sides of small incipient drainageways or on terrace breaks. Some of these soils are uneroded; others show moderate to severe erosion. Because of their position, the soils of this group are difficult to till and manage as separate units. All are susceptible to water erosion.

The soils in this group are best used as permanent grassland. As a matter of convenience, they are generally tilled along with other tilled soils. However, it is possible to till them successfully if they are properly managed. When tilled, they are suited to most crops grown in the county. Because of their susceptibility to water erosion, clean-tilled crops should be used as infrequently as possible. A well-planned cropping sequence, including frequent use of legume crops, should be followed. The use of manures and crop residues also is important in the management. Since control of erosion is critical to continued productivity, tilled or barren areas should be returned to permanent grassland wherever it is practical to do so. The soils in this group are:

Detroit silt loam, 2 to 6 percent slopes.
Fore silty clay loam, deep over silt, 2 to 6 percent slopes.
Hall silt loam, 2 to 6 percent slopes.
Hall silt loam, 2 to 6 percent slopes, eroded.
Hall silt loam, brown subsoil variant, 2 to 6 percent slopes.
Humbarger silt loam, 2 to 6 percent slopes.
Humbarger silt loam, 2 to 6 percent slopes, eroded.
Humbarger silt loam, 2 to 6 percent slopes, severely eroded.
Langley silt loam, 2 to 6 percent slopes.
Langley silty clay loam, 2 to 6 percent slopes, eroded.
Muir silt loam, 2 to 6 percent slopes.
Windom loam, 2 to 6 percent slopes.
Windom fine sandy loam, 2 to 6 percent slopes.

Group 19A.—The soils in this group are medium textured to moderately fine textured and slightly acid to moderately acid. They generally occur on the terraces along the smaller streams in the northern and western parts of the county. Slopes range from 0 to 2 percent. These soils may be flooded, but crop losses from this cause are infrequent. They are subject to wind erosion if left unprotected during the spring. The soils generally have adequate supplies of available phosphorus and nitrogen.

The soils in this group may be used either as cropland or as permanent grassland. They are best suited to crops that are tolerant to slight to moderate acidity. However, most crops common to the county may be grown on these soils.

A cropping sequence that includes a legume crop is desirable, but lime should be applied before seeding the legume. The use of plant residues and the management of the plant cover are

important. Surfaces should not be left bare for long periods, particularly during the spring. Both the time of tillage and type of tillage are important. Excess pulverization of these soils during tillage will increase their susceptibility to wind erosion. The soils in this group are:

Detroit silt loam, overwash phase, 0 to 2 percent slopes.
Salemsburg silt loam, 0 to 2 percent slopes.
Smoky Butte silt loam, 0 to 2 percent slopes.
Tobin silt loam, 0 to 2 percent slopes.

Group 19B.—The soils in this group are medium textured to moderately fine textured and slightly acid to moderately acid. Slopes range from 2 to 6 percent. They generally occur as narrow, elongated bodies on the faces of terrace breaks, or on the sides and banks of small drainageways. Because of their position, the soils are difficult to till and manage as separate units. They are moderately susceptible to both wind and water erosion.

The soils in this group are best used as permanent grassland wherever they are difficult to till and manage. Where tillage is practical, they are suited to most crops grown in the county. A cropping sequence that will help maintain fertility and prevent erosion is desirable. These soils should not be left bare for long periods. The proper use of crop refuse is important. Lime should be applied before seeding legume crops. The soils in this group are:

Detroit silt loam, overwash phase, 2 to 6 percent slopes.
Tobin silt loam, 2 to 6 percent slopes.

Group 20.—In this group are dark-colored, medium textured to moderately fine textured, imperfectly drained to poorly drained soils of the flood plains and terraces. They occur on slopes of 0 to 2 percent in level to slightly concave parts of the terraces. The soils are underlain by fine-textured substrata at depths of 4 to 5 feet. The level of the ground water fluctuates over this substratum and causes the lower part of the soil profile to be imperfectly or poorly drained. The soils are susceptible to wind erosion if left unprotected for long periods or if improperly tilled. With the exception of Marydel loamy fine sand, they are not deficient in plant nutrients. Marydel loamy fine sand is deficient in available phosphorus.

The soils in this group may be used as cropland or as permanent grassland. They are suited to most crops grown in the county. Management practices should include a well-planned cropping sequence, the use of legume crops, the incorporation of plant residues in the surface layer, and the use of plant cover to protect the soils from wind erosion in spring. Emergency tillage is needed if wind erosion starts. Marydel loamy fine sand is deficient in phosphorus, so on it most crops respond to applications of phosphorus fertilizers. The soils in this group are:

Marydel silt loam, 0 to 2 percent slopes.
Marydel loam, poorly drained variant, 0 to 2 percent slopes.
Marydel fine sandy loam, 0 to 2 percent slopes.
Marydel loamy fine sand, 0 to 2 percent slopes.

Group 21A.—In this group are deep, moderately sandy, alluvial soils on slopes of 0 to 2 percent. They occur on flood plains and terraces, are moderately dark colored, and range from neutral to calcareous. They are productive but are also somewhat droughty late in summer. Unless these soils are protected by a plant cover, they are susceptible to wind erosion. When eroded, they tend to be deficient in nitrogen. The Humbarger soil usually is deficient in phosphorus.

The soils in this group may be used either as cropland or as permanent grassland. They may be used for most tilled crops but are best suited to wheat and sorghum. Management practices should include the use of a cropping sequence that includes a legume crop, the incorporating of plant residues in the surface layer, the use of stubble as cover, and, when necessary, the use of emergency tillage to control wind erosion. On the Humbarger soil most crops require supplemental applications of phosphorus fertilizers. The soils in this group are:

Arkansas fine sandy loam, 0 to 2 percent slopes.
Humbarger loam, 0 to 2 percent slopes.

Group 21B.—This group consists of deep, moderately sandy, alluvial soils on slopes of 2 to 6 percent. They show minor to moderate erosion. Usually they occur as narrow, elongated areas on the faces of terrace breaks or on the sides of drainage channels on the terraces. Since these soils are often difficult to till and manage, it is better to use them as permanent grasslands. The soils in this group are:

Arkansas fine sandy loam, 2 to 6 percent slopes.
Humbarger loam, 2 to 6 percent slopes.
Humbarger loam, 2 to 6 percent slopes, eroded.

Group 22A.—In this group are deep, sandy, excessively drained, soils of the flood plains and terraces. They generally occur near river channels or on natural levees bordering the smaller streams. Slopes range from 0 to 6 percent. The soils tend to be droughty and in dry seasons are subject to wind erosion. They usually are deficient in available phosphorus and nitrogen, but their productivity—even when these elements are supplied—is largely dependent upon the amount and distribution of rainfall. Where these soils occur on 2 to 6 percent slopes, their relief is most important in their use and management. On terrace faces and the sides of small drainage channels they are difficult to till and manage. Adjacent to river channels these soils occur on large uneven and undulating areas that are easily tilled.

The soils in this group are best used as permanent grassland. With careful management, however, they may be used for crops. When tilled, they are best suited to sorghums. The selection of a suitable cropping sequence, the use of manures, and the proper management of stubble and crop residues are important. The use of costly fertilizers is questionable, since the successful growth of crops on these soils depends largely on the rainfall. Because these soils are droughty and subject to wind erosion, positions that are difficult to manage should be returned to permanent grass as soon as possible. The soils in this group are:

Albion loam, 2 to 6 percent slopes.
Detroit loamy very fine sand, overwash phase, 0 to 2 percent slopes.
Lincoln loamy fine sand, 0 to 2 percent slopes.
Lincoln loamy fine sand, 2 to 6 percent slopes.
Windom loamy fine sand, sandy substratum variant, 0 to 2 percent slopes.
Windom loamy fine sand, sandy substratum variant, 2 to 6 percent slopes.

Group 22B.—The soil in this group is deep, sandy, and excessively drained. Slopes range from 6 to 12 percent. The soil is confined almost entirely to terrace faces and is unsuited to cultivation. Most of the areas are now in permanent grass. The soil of this group is the following:

Albion loam, 6 to 12 percent slopes.

Group 23.—The soils in this group occur in close association with Solonetz soils on 0 to 2 percent slopes. The Solonetz soils, or salt spots, occur so frequently in some areas that they affect use and management.

The best use for these soils depends upon the number of Solonetz spots. Where as much as 50 percent of the area is in Solonetz spots, the soils are best used for permanent grass. Where less than 50 percent of an area is covered by Solonetz spots, tillage may be practical under careful management. This includes the proper management of stubble and other surface cover to prevent wind erosion and the use of a well-planned cropping sequence that includes sweetclover.

Tilled areas are best suited to early maturing small grains. The use of supplemental fertilizers that supply both phosphorus and nitrogen increases plant growth, provides greater yields, and aids in the reclamation of the Solonetz spots. The application of fertilizers to the Solonetz spots has not been effective in increasing their productivity. Heavy applications of barnyard manures and gypsum have been beneficial in some instances. Reclamation of the Solonetz spots is largely dependent upon opening up the fine-textured clay subsoil to permit leaching of the toxic salts. In some areas the use of ditches may be necessary to provide adequate surface drainage. The soils in this group are:

Bonaccord silty clay loam-Solonetz complex, 0 to 2 percent slopes.
Langley silt loam-Solonetz complex, 0 to 2 percent slopes.

Group 24.—This group includes land types made up of soils that have little or no agricultural value. The individual units differ widely. Made land consists of areas occupied by structural cuts and fills. Alluvial lands are confined largely to the steep slopes along the Smoky Hill and Solomon Rivers. They are usually timbered and are probably best used as a source of wood for local use. In some areas they are of value as grazing land. Rough broken and rough stony land, Vernon and Hedville soil materials, has extreme slopes and is principally bare rock or shale outcrops that support only a thin cover of grass. The areas are of limited value as grazing land. It is difficult for stock to move over them, and they interfere with cultivation in fields where they occur. The miscellaneous land types in this group are:

Alluvial land.
Made land, 0 to 2 percent slopes.
Rough broken and rough stony land, Vernon and Hedville soil materials.

ESTIMATED YIELDS OF PRINCIPAL CROPS

Table 7 gives estimated average acre yields of wheat, corn, and alfalfa hay for each soil type under two levels of management. The estimates in columns A are for yields obtained under common practices. Under common practices, wheat is the principal crop grown. Other crops are substituted at infrequent intervals, but an established pattern of cropping is not followed. Legume crops are grown at indefinite intervals for seed and hay and not specifically for their value as a soil-improvement crop.

Yields under more careful and intensive practices are given in columns B. These practices include (1) use of a well-planned cropping sequence that includes legumes wherever it is practical to grow them, (2) use of manures and crop residues, (3) application of lime and fertilizers as needed, and (4) control of erosion by such practices as contour tillage, stripcropping, terracing, construction of drainageways, growth of cover crops, proper time of tillage, emergency tillage, and avoiding overtillage.

The estimates in table 7 are based on available information regarding crop yields, which includes (1) interviews with farmers, the county agent, and members of the Kansas Agricultural Experiment Station; (2) observations made by members of the soil survey party, farm records, and Agricultural Marketing Service records; and (3) the results obtained by the experiment station on experimental farms.

The yields in table 7 are estimates of average production over a period of years. They may not apply directly to any specific tract of land in any particular year, because management practices and soil characteristics differ slightly from farm to farm, and because climate fluctuates. Their main value is to bring out the relative productivity of the soils. Yields given for improved practices generally are greater than those obtained under common practices; however, the difference is greater on some soils than on others, depending on the kind of deficiency. For example, a deficiency in fertility can generally be corrected, but a sandy droughty soil will not produce large yields, even if it is not deficient in any plant element.

LAND CAPABILITY CLASSIFICATION

The soils of Saline County have been grouped to show their suitability for crops, grazing, forestry, and wildlife. This grouping is based on the uses that can be made of each soil, its needs for management, and the hazards of soil erosion or other damage when it is used. Since it is a practical grouping based on needs and responses, it can bring together, in one group, soils that were formed from different parent materials or in different ways.

There are eight general land capability classes, but all do not necessarily occur in a particular area. Class I land is nearly level and has few limitations; the soils are productive and not subject to erosion. Class VIII land has little or no useful vegetation because the soils are too rough or stony, too wet or droughty, or are limited in some other way.

TABLE 7.—*Estimated average acre yield of principal crops*

[Yields in columns A obtained under common practices; those in columns B obtained with improved management (see text for definition of management at common and improved levels); absence of a yield figure indicates crop is not commonly grown under the management level indicated]

Soil type	Wheat		Corn		Alfalfa hay	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Albion loam	10	15	17	20	1.5	1.8
Albion coarse sandy loam, shallow phase						
Arkansas fine sandy loam	14	20	35	40	3.0	3.5
Assaria silt loam	15	21	25	30	2.2	3.0
Assaria silty clay loam	12	20	17	30	1.8	3.0
Benfield silty clay loam	13	18	20	30	2.0	3.0
Benfield silty clay loam, shallow phase	7	18	12	15	1.5	2.0
Berg silt loam	15	23	25	35	2.0	3.5
Berg silty clay loam	7	14			1.2	2.0
Bonaccord silty clay loam	16	24	28	35	2.8	3.2
Bonaccord silty clay loam—Solonetz complex	10	15	16	22	1.2	2.0
Carlson silty clay loam						
Cloud silty clay loam	3	7				
Detroit silt loam	19	26	40	45	4.0	4.5
Detroit silty clay loam	18	26	35	40	3.5	4.0
Detroit silt loam, overwash phase	12	18	25	35	2.8	3.5
Detroit loamy very fine sand, overwash phase	10	15	20	25	2.0	2.5
Ebenezer silt loam	10	17	14	20	1.5	2.5
Ebenezer silty clay loam	7	12	10	20	1.0	2.5
Ebenezer loam	9	17	11	20	1.5	2.5
Ebenezer silt loam, colluvial phase	13	19	20	30	2.2	3.5
Edalgo silt loam	6	10	12	16	1.0	1.5
Elmo silt loam	14	21	25	35	2.0	3.5
Elmo silty clay loam	11	16	20	35	1.8	3.5
Elmo loam, terrace phase	14	21	32	40	2.5	4.0
Elmo silt loam, terrace phase	14	21	35	40	2.8	4.0
Englund silt loam	8	12	13	20	1.2	2.2
Englund silty clay loam, very shallow variant	3	7				
Falun fine sandy loam	16	21	28	35	3.0	4.0
Fore clay	13	16	15	20	1.5	2.0
Fore silty clay loam, deep over silt	14	18	32	40	3.5	4.0
Geary silt loam	13	18	25	35	2.8	3.5
Hall silt loam	17	26	35	45	3.3	4.5
Hall silt loam, brown subsoil variant	17	26	35	45	3.3	4.5
Hallville loam	8	10				
Hallville loam, shallow phase	6	8				
Hedville loam						
Hedville stony loam						
Hobbs silt loam	15	23	30	40	3.5	4.0
Humbarger silt loam	16	23	34	40	3.2	4.0
Humbarger loam	15	18	25	35	2.8	3.5
Idana silt loam	13	23	20	30	1.5	3.0
Idana silty clay loam	10	18	17	30	1.2	3.0
Kipp silt loam	12	12	18	20	1.8	2.0
Kipp silty clay loam	10	12	17	20	1.5	2.0
Kipson silt loam	9	11			1.0	1.0

TABLE 7.—*Estimated average acre yield of principal crops*—*Continued*

Soil type	Wheat		Corn		Alfalfa hay	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Kipson shaly silt loam	3	6				
Lancaster loam	10	14	15	30	2.0	3.0
Lancaster loam, shallow phase	7	10	12	25	1.5	2.5
Lancaster fine sandy loam	9	13	12	25	1.5	2.5
Lancaster fine sandy loam, shallow phase	7	9	10	20	1.0	2.0
Langley silt loam	16	22	35	45	3.5	4.5
Langley silty clay loam	12	22	28	40	3.2	4.0
Langley silt loam—Solonetz complex	11	15	20	30	2.1	3.0
Lanham silt loam	6	9	12	20	1.5	2.0
Lincoln loamy fine sand	10	13	15	15	1.5	1.5
Lindsborg silt loam	3	5				
Lockhard silt loam	15	22	25	30	2.8	3.0
Lockhard loamy fine sand, overblown phase	11	16	15	15	1.2	1.2
Longford silt loam	15	18	25	30	2.0	2.5
Longford silty clay loam	10	15	15	30	1.5	2.5
Malmgren silt loam	12	16	20	30	2.2	2.5
Marydel silt loam	16	23	40	45	3.5	4.5
Marydel loam, poorly drained variant	14	18	20	35	2.2	3.5
Marydel fine sandy loam	15	20	30	40	2.8	4.0
Marydel loamy fine sand	10	15	15	20	1.5	2.0
McPherson silt loam	16	20	26	30	2.5	3.0
Muir silt loam	16	26	40	45	4.0	4.5
New Cambria silty clay loam	16	25	30	40	3.1	4.0
Niles silt loam	15	19	25	30	2.2	3.0
Niles silty clay loam	12	17	18	30	2.0	3.0
Ninnescah silt loam	14	18	30	35	2.0	3.5
Pratt fine sandy loam	10	14	15	18	1.5	1.8
Rentide silt loam	13	16	11	15	1.5	2.0
Rentide silty clay loam	10	15	9	15	1.0	2.0
Rentide silt loam, moderately shallow phase	7	12	9	15	1.0	2.0
Rokeby silt loam	15	20	25	30	2.2	3.0
Roxbury silty clay loam	18	24	35	40	2.5	3.0
Salemsburg silt loam	15	22	37	45	3.0	4.0
Shellabarger silt loam	13	20	25	35	3.8	3.5
Shellabarger loam	12	20	25	35	2.8	3.5
Shellabarger fine sandy loam	10	16	20	30	2.2	3.0
Smoky Butte silt loam	15	24	35	45	3.0	4.0
Smolan silt loam	14	18	22	30	2.5	3.0
Solomon clay	15	19	15	25	3.0	3.5
Solomon clay, low lime variant	10	14	12	25	2.0	2.5
Stimmel silt loam	16	21	30	35	3.0	4.0
Stimmel silty clay loam	12	20	25	35	2.5	4.0
Sutphen silty clay	16	20	30	35	3.4	4.0
Tescott silt loam	13	18	11	20	1.5	2.0
Tescott silty clay loam	8	13	8	20	1.2	2.0
Tobin silt loam	15	26	30	45	3.0	4.5
Vernon silty clay loam	6	10				
Wabash silty clay loam	15	21	32	40	3.4	4.0
Westfall silt loam	10	18	15	30	2.2	3.0
Westfall silty clay loam	9	17	12	30	2.0	3.0

TABLE 7.—*Estimated average acre yield of principal crops —Continued*

Soil type	Wheat		Corn		Alfalfa hay	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu*	*Bu.*	*Tons*	*Tons*
Windom loam	16	23	32	40	3.0	4.0
Windom fine sandy loam	16	23	32	40	2.8	3.8
Windom loamy fine sand, sandy substratum variant	10	15	15	20	1.0	1.5
Yordy loam	14	18	18	25	2.0	2.5
Yordy silty clay loam	12	18	15	25	1.8	2.5
Yordy loam, shallow phase	9	14	10	12	1.5	2.0
Yordy silty clay loam, shallow phase	7	13	10	12	1.0	2.0

Class I soils are at least fairly fertile and are not subject to more than slight erosion, drought, or wetness. They can be used for crops ordinarily grown in the locality without special practices, other than those needed for good farming anywhere. The farmer can choose one of several cropping patterns or use the soil for pasture, trees, or other purposes.

Soils placed in class II and class III are subject to slight or moderate erosion, are too wet, or have other management needs that are successively greater than those on soils in class I. Soils in class IV are less suitable for regular cropping than those in the first three classes, but they are suitable for tillage part of the time or with special precautions. These classes are ordinarily well suited for uses that require little or no cultivation, such as grazing, forestry, or wildlife. Management needs and probable yields can vary a great deal on the different soils.

Soils not suitable for cultivation, or that require extreme management of any kind, including those subject to severe erosion if cultivated, are placed in classes V, VI, VII, or VIII. Class V contains soils that are nearly level and not subject to erosion, but they are too wet, too frequently overflowed, or too stony for cultivation. There are no class V soils in Saline County. Soils placed in class VI are steep, droughty, or shallow, but they produce fairly good amounts of grass or are suitable sites for trees. As a rule class VI soils should not be cultivated, but some of them can be cultivated enough to prepare them for planting trees or seeding permanent grasses.

Soils in class VII are more limited than those in class VI. They require more careful management and usually give only fair to poor yields of forage. Class VIII consists of soils so severely limited they produce little useful vegetation. They may have value as wildlife habitats.

SUBCLASSES: Each of the eight classes contains soils that have limitations and management problems of about the same degree. The soils within a class may be of different kinds, however, and

therefore the kinds of limitations are different. The dominant kind of limitation is indicated by one of three subclasses. The three subclasses are shown thus: Soil subject to erosion if cover is not maintained, symbol (e); excess water either on or in the soil (w); or shallow, droughty, or saline soil (s). All the subclasses do not usually occur on a particular land class in an area the size of a county.

The capability classes and subclasses in Saline County are given in the following list. Only the general nature of the principal soils in each subclass is described.

Class I.—Soils safe for use under intensive cultivation, without special practices to control runoff or erosion, and which may be expected to produce high yields under good soil and crop management.

Class II.—Soils that can be used for tilled crops but under slight risks of erosion or other slight limitations.

- IIe: Nearly level soils subject to slight risk of erosion if not protected, or which have other slight problems of management.
- IIw: Nearly level soils of slow internal drainage which are slightly affected by excess water.

Class III.—Soils that can be used for tilled crops, but under moderate risks of erosion or other moderate limitations.

- IIIe: Gently sloping soils subject to moderate risk of erosion if not protected.
- IIIw: Level soils of very slow internal drainage which are moderately affected by excess water.

Class IV.—Soils that have severe limitations or high risks of soil damage when used for cultivation and when so used require special management.

- IVe: Soils with high risks of soil damage by erosion.
- IVs: Soils affected by moderate degrees of salinity and requiring special management.

Class VI.—Soils that are too shallow, steep, or eroded for cultivation; suitable for grass; some suitable for trees.

- VIe: Soils that are steep, shallow, or severely eroded.
- VIw: Soils that are severely affected by excess water.
- VIs: Shallow, rocky soils.

Class VII.—Soils that are unsuitable for cultivation and that usually produce only fair or poor amounts of forage or wood products; too shallow or erodible for cultivation and of low suitability for grazing.

- VIIs: Very steep, shallow or rocky soils.
- VIIw: Streambanks subject to frequent flooding and bank erosion.

The soils of Saline County are listed by class and subclass as follows:

	Soil symbol	*Capability class and subclass*
Albion coarse sandy loam, shallow phase, 2 to 6 percent slopes	Aa	VIs
Albion loam, 2 to 6 percent slopes	Ab	IIIe
Albion loam, 6 to 12 percent slopes	Ac	VIe
Alluvial land	Ad	VIIw
Arkansas fine sandy loam, 0 to 2 percent slopes	Ae	IIe
Arkansas fine sandy loam, 2 to 6 percent slopes	Af	IVe
Assaria silt loam, 2 to 6 percent slopes	Ag	IIIe
Assaria silty clay loam, 2 to 6 percent slopes, eroded	Ah	IVe
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes	Bd	IVe
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, eroded	Be	IVe
Benfield silty clay loam, shallow phase, 2 to 6 percent slopes, severely eroded	Bf	VIe
Benfield silty clay loam, shallow phase, 6 to 12 percent slopes, severely eroded	Bg	VIe
Benfield silty clay loam, 2 to 6 percent slopes	Bh	IIIe
Benfield silty clay loam, 2 to 6 percent slopes, eroded	Bb and Bk	IIIe
Benfield silty clay loam, 2 to 6 percent slopes, severely eroded	Bc and Bl	IVe
Berg silt loam, 0 to 2 percent slopes	Bm	IIe
Berg silt loam, 2 to 6 percent slopes	Bn	IIIe
Berg silty clay loam, 2 to 6 percent slopes, eroded	Bo	IIIe
Berg silty clay loam, 2 to 6 percent slopes, severely eroded	Bp	IVe
Bonaccord silty clay loam, 0 to 2 percent slopes	Br	IIw
Bonaccord silty clay loam, 2 to 6 percent slopes	Bs	IIIe
Bonaccord silty clay loam, 2 to 6 percent slopes, eroded	Bt	IIIe
Bonaccord silty clay loam-Solonetz complex, 0 to 2 percent slopes	Bu	IVs
Carlson silty clay loam, 2 to 6 percent slopes	Ca	IIIe
Carlson silty clay loam, 6 to 12 percent slopes	Cb	VIe
Cloud silty clay loam, 2 to 6 percent slopes	Cc	VIs
Cloud silty clay loam, 6 to 12 percent slopes	Cd	VIs
Cloud silty clay loam, 6 to 12 percent slopes, severely eroded	Ce	VIs
Detroit loamy very fine sand, overwash phase, 0 to 2 percent slopes	Da	IIIe
Detroit silt loam, 0 to 2 percent slopes	Db	I
Detroit silt loam, 2 to 6 percent slopes	Dc	IIIe
Detroit silt loam, overwash phase, 0 to 2 percent slopes	Dd	I
Detroit silt loam, overwash phase, 2 to 6 percent slopes	De	IIIe
Detroit silty clay loam, 0 to 2 percent slopes	Df	I
Detroit silty clay loam, 2 to 6 percent slopes	Dg	VIw
Detroit silty clay loam, 2 to 6 percent slopes, eroded	Dh	VIw
Ebenezer loam, 2 to 6 percent slopes	Ea	IIIe
Ebenezer silt loam, 0 to 2 percent slopes	Eb	IIe
Ebenezer silt loam, 2 to 6 percent slopes	Ec	IIIe
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes	Ed	IIIe
Ebenezer silt loam, colluvial phase, 2 to 6 percent slopes, eroded	Ee	IIIe
Ebenezer silty clay loam, 0 to 2 percent slopes, eroded	Ef	IIe

	Soil symbol	*Capability class and subclass*
Ebenezer silty clay loam, 2 to 6 percent slopes, eroded	Eg	IIIe
Ebenezer silty clay loam, 2 to 6 percent slopes, severely eroded	Eh	IVe
Ebenezer silty clay loam, 6 to 12 percent slopes, eroded	Ek	IIIe
Edalgo silt loam, 2 to 6 percent slopes	El	IVe
Edalgo silt loam, 2 to 6 percent slopes, eroded	Em	IVe
Edalgo silt loam, 6 to 12 percent slopes	En	VIe
Edalgo silt loam, 2 to 6 percent slopes, severely eroded	Eo	VIe
Edalgo silt loam, 6 to 12 percent slopes, severely eroded	Ep	VIe
Elmo loam, terrace phase, 2 to 6 percent slopes	Er	IIIe
Elmo loam, terrace phase, 2 to 6 percent slopes, eroded	Es	IIIe
Elmo silt loam, terrace phase, 0 to 4 percent slopes	Et	IIIe
Elmo silt loam, terrace phase, 0 to 4 percent slopes, eroded	Eu	IIIe
Elmo silt loam, 2 to 6 percent slopes	Ev	IIIe
Elmo silt loam, 6 to 12 percent slopes	Ew	IVe
Elmo silty clay loam, 2 to 6 percent slopes, severely eroded	Ex	IVe
Elmo silty clay loam, 6 to 12 percent slopes, severely eroded	Ey	VIe
Englund silt loam, 2 to 6 percent slopes	Ez	IIIe
Englund silt loam, 2 to 6 percent slopes, eroded	Eza	IVe
Englund silt loam, 2 to 6 percent slopes, severely eroded	Ezb	VIe
Englund silty clay loam, very shallow variant, 2 to 6 percent slopes	Ezc	VIs
Falun fine sandy loam, 0 to 2 percent slopes	Fa	I
Falun fine sandy loam, 2 to 6 percent slopes	Fb	VIw
Fore clay, 0 to 2 percent slopes	Fc	IIIw
Fore clay, 2 to 6 percent slopes	Fd	VIw
Fore silty clay loam, deep over silt, 0 to 2 percent slopes	Fe	I
Fore silty clay loam, deep over silt, 2 to 6 percent slopes	Ff	IIIe
Geary silt loam, 2 to 6 percent slopes	Ga	IIIe
Geary silt loam, 2 to 6 percent slopes, eroded	Gb	IIIe
Geary silt loam, 6 to 12 percent slopes	Gc	IVe
Geary silt loam, 6 to 12 percent slopes, severely eroded	Gd	VIe
Hall silt loam, 0 to 2 percent slopes	Ha	I
Hall silt loam, 2 to 6 percent slopes	Hb	IIIe
Hall silt loam, 2 to 6 percent slopes, eroded	Hc	IIIe
Hall silt loam, brown subsoil variant, 0 to 2 percent slopes	Hd	I
Hall silt loam, brown subsoil variant, 2 to 6 percent slopes	He	IIIe
Hallville loam, 2 to 6 percent slopes	Hf	VIs
Hallville loam, 2 to 6 percent slopes, eroded	Hg	VIs
Hallville loam, 6 to 12 percent slopes	Hh	VIs
Hallville loam, 6 to 12 percent slopes, severely eroded	Hk	VIs
Hallville loam, shallow phase, 2 to 6 percent slopes	Hl	VIs
Hallville loam, shallow phase, 2 to 6 percent slopes, severely eroded	Hm	VIs
Hallville loam, shallow phase, 6 to 12 percent slopes	Hn	VIs
Hallville loam, shallow phase, 6 to 12 percent slopes, severely eroded	Ho	VIs
Hedville loam, 2 to 6 percent slopes	Hp	VIs

	Soil symbol	*Capability class and subclass*
Hedville loam, 2 to 6 percent slopes, eroded	Hr	VIs
Hedville loam, 6 to 12 percent slopes	Hs	VIs
Hedville stony loam, 2 to 6 percent slopes	Ht	VIs
Hedville stony loam, 6 to 12 percent slopes	Hu	VIs
Hobbs silt loam, 0 to 2 percent slopes	Hv	I
Hobbs silt loam, 0 to 2 percent slopes, eroded	Hw	I
Hobbs silt loam, 2 to 6 percent slopes	Hx	VIw
Hobbs silt loam, 2 to 6 percent slopes, eroded	Hy	VIw
Hobbs silt loam, light-colored variant, 0 to 2 percent slopes	Hz	I
Humbarger loam, 0 to 2 percent slopes	Hza	IIe
Humbarger loam, 2 to 6 percent slopes	Hzb	IVe
Humbarger loam, 2 to 6 percent slopes, eroded	Hzc	IVe
Humbarger silt loam, 0 to 2 percent slopes	Hzd	I
Humbarger silt loam, 2 to 6 percent slopes	Hze	IIIe
Humbarger silt loam, 2 to 6 percent slopes, eroded	Hzf	IIIe
Humbarger silt loam, 2 to 6 percent slopes, severely eroded	Hzg	IIIe
Idana silt loam, 2 to 6 percent slopes	Ia	IIIe
Idana silt loam, 2 to 6 percent slopes, eroded	Ib	IVe
Idana silty clay loam, 2 to 6 percent slopes, severely eroded	Ic	VIe
Idana silty clay loam, 6 to 12 percent slopes, eroded	Id	IVe
Kipp silt loam, 2 to 6 percent slopes	Ka	IIIe
Kipp silt loam, 6 to 12 percent slopes	Kb	IVe
Kipp silty clay loam, 2 to 6 percent slopes, eroded	Kc	IVe
Kipp silty clay loam, 2 to 6 percent slopes, severely eroded	Kd	VIe
Kipp silty clay loam, 6 to 12 percent slopes, severely eroded	Ke	VIe
Kipson shaly silt loam, 2 to 6 percent slopes, eroded	Kf	VIs
Kipson shaly silt loam, 6 to 12 percent slopes, severely eroded	Kg	VIs
Kipson silt loam, 2 to 6 percent slopes	Kh	VIs
Kipson silt loam, 6 to 12 percent slopes	Kk	VIs
Kipson silt loam, over 12 percent slopes	Kl	VIs
Lancaster fine sandy loam, 2 to 6 percent slopes	La	IIIe
Lancaster fine sandy loam, 2 to 6 percent slopes, eroded	Lb	IIIe
Lancaster fine sandy loam, 2 to 6 percent slopes, severely eroded	Lc	VIe
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes	Ld	IVe
Lancaster fine sandy loam, shallow phase, 2 to 6 percent slopes, eroded	Le	IVe
Lancaster fine sandy loam, 6 to 12 percent slopes	Lf	IVe
Lancaster fine sandy loam, shallow phase, 6 to 12 percent slopes	Lg	VIe
Lancaster loam, 2 to 6 percent slopes	Lh	IIIe
Lancaster loam, 2 to 6 percent slopes, eroded	Lk	IIIe
Lancaster loam, 2 to 6 percent slopes, severely eroded	Ll	VIe
Lancaster loam, shallow phase, 2 to 6 percent slopes	Lm	IVe
Lancaster loam, shallow phase, 2 to 6 percent slopes, eroded	Ln	IVe
Lancaster loam, 6 to 12 percent slopes	Lo	IVe
Lancaster loam, 6 to 12 percent slopes, severely eroded	Lp	VIe
Lancaster loam, shallow phase, 6 to 12 percent slopes	Lr	VIe
Langley silt loam, 0 to 2 percent slopes	Ls	I
Langley silt loam, 2 to 6 percent slopes	Lt	IIIe
Langley silty clay loam, 2 to 6 percent slopes, eroded	Lu	IIIe

	Soil symbol	*Capability class and subclass*
Langley silt loam-Solonetz complex, 0 to 2 percent slopes	Lv	IVs
Lanham silt loam, 2 to 6 percent slopes	Lw	IVe
Lanham silt loam, 2 to 6 percent slopes, severely eroded	Lx	VIe
Lanham silt loam, 6 to 12 percent slopes	Ly	VIe
Lincoln loamy fine sand, 0 to 2 percent slopes	Lz	IIIe
Lincoln loamy fine sand, 2 to 6 percent slopes	Lza	IIIe
Lindsborg silt loam, 0 to 2 percent slopes	Lzb	IIIw
Lockhard loamy fine sand, overblown phase, 2 to 6 percent slopes	Lzc	IIIe
Lockhard silt loam, 0 to 2 percent slopes	Lzd	IIe
Lockhard silt loam, 0 to 2 percent slopes, eroded	Lze	IIe
Lockhard silt loam, 2 to 6 percent slopes	Lzf	IIIe
Lockhard silt loam, 2 to 6 percent slopes, eroded	Lzg	IIIe
Lockhard silt loam, 2 to 6 percent slopes, severely eroded	Lzh	IVe
Longford silt loam, 0 to 2 percent slopes	Lzk	IIe
Longford silt loam, 2 to 6 percent slopes	Lzl	IIIe
Longford silty clay loam, 2 to 6 percent slopes, eroded	Lzm	IIIe
Made land, 0 to 2 percent slopes (variable; not classified).		
Malmgren silt loam, 0 to 2 percent slopes	Mb	IIIe
Malmgren silt loam, 2 to 6 percent slopes	Mc	IIIe
Marydel fine sandy loam, 0 to 2 percent slopes	Md	I
Marydel loam, poorly drained variant, 0 to 2 percent slopes	Me	I
Marydel loamy fine sand, 0 to 2 percent slopes	Mf	I
Marydel silt loam, 0 to 2 percent slopes	Mg	I
McPherson silt loam, 0 to 3 percent slopes	Ma	IIw
Muir silt loam, 0 to 2 percent slopes	Mh	I
Muir silt loam, 2 to 6 percent slopes	Mk	IIIe
New Cambria silty clay loam, 0 to 2 percent slopes	Na	I
Niles silt loam, 0 to 2 percent slopes	Nb	IIw
Niles silt loam, 2 to 6 percent slopes	Nc	IIIe
Niles silty clay loam, 0 to 2 percent slopes, eroded	Nd	IIe
Niles silty clay loam, 2 to 6 percent slopes, eroded	Ne	IIIe
Niles silty clay loam, 2 to 6 percent slopes, severely eroded	Nf	VIe
Niles silt loam, 2 to 6 percent slopes, severely eroded	Ng	VIe
Ninnescah silt loam, 0 to 2 percent slopes	Nh	IIe
Ninnescah silt loam, 2 to 6 percent slopes	Nk	IIIe
Pratt fine sandy loam, 2 to 6 percent slopes	Pa	IIIe
Pratt fine sandy loam, 2 to 6 percent slopes, eroded	Pb	IIIe
Rentide silt loam, 2 to 6 percent slopes	Ra	IIIe
Rentide silt loam, moderately shallow phase, 2 to 6 percent slopes	Rb	IVe
Rentide silty clay loam, 2 to 6 percent slopes, eroded	Rc	IVe
Rokeby silt loam, 0 to 2 percent slopes	Rd	IIw
Rough broken and rough stony land, Vernon and Hedville soil material	Re	VIIs
Roxbury silty clay loam, 0 to 2 percent slopes	Rf	I
Roxbury silty clay loam, 2 to 6 percent slopes, eroded	Rg	VIw
Salemsburg silt loam, 0 to 2 percent slopes	Sa	I
Shellabarger fine sandy loam, 2 to 6 percent slopes	Sb	IIIe
Shellabarger fine sandy loam, 2 to 6 percent slopes, eroded	Sc	IIIe
Shellabarger fine sandy loam, 2 to 6 percent slopes, severely eroded	Sd	IVe
Shellabarger loam, 2 to 6 percent slopes	Se	IIIe
Shellabarger loam, 2 to 6 percent slopes, eroded	Sf	IIIe
Shellabarger loam, 2 to 6 percent slopes, severely eroded	Sg	IVe

	Soil symbol	Capability class and subclass
Shellabarger loam, 6 to 12 percent slopes, eroded	Sh	VIe
Shellabarger silt loam, 0 to 2 percent slopes	Sk	IIe
Shellabarger silt loam, 2 to 6 percent slopes	Sl	IIIe
Shellabarger silt loam, 2 to 6 percent slopes, eroded	Sm	IIIe
Smoky Butte silt loam, 0 to 2 percent slopes	Sn	I
Smolan silt loam, 2 to 6 percent slopes	So	IIIe
Smolan silt loam, 2 to 6 percent slopes, eroded	Sp	IIIe
Smolan silt loam, 2 to 6 percent slopes, severely eroded	Sr	IVe
Solomon clay, 0 to 2 percent slopes	Ss	IIw
Solomon clay, low-lime variant, 0 to 2 percent slopes	St	IIw
Stimmel silt loam, 0 to 2 percent slopes	Su	IIw
Stimmel silt loam, 2 to 6 percent slopes	Sv	IIIe
Stimmel silty clay loam, 2 to 6 percent slopes, severely eroded	Sw	VIes
Sutphen silty clay, 0 to 2 percent slopes	Sx	IIw
Tescott silt loam, 2 to 6 percent slopes	Ta	IIIe
Tescott silty clay loam, 2 to 6 percent slopes, eroded	Tb	IVe
Tobin silt loam, 0 to 2 percent slopes	Tc	I
Tobin silt loam, 2 to 6 percent slopes	Td	IIIe
Vernon silty clay loam, 2 to 6 percent slopes	Va	VIs
Vernon silty clay loam, 2 to 6 percent slopes, severely eroded	Vb	VIs
Vernon silty clay loam, 6 to 12 percent slopes	Vc	VIs
Wabash silty clay loam, 0 to 2 percent slopes	Wa	IIw
Westfall silt loam, 2 to 6 percent slopes	Wb	IIIe
Westfall silty clay loam, 2 to 6 percent slopes, eroded	Wc	IIIe
Westfall silty clay loam, 2 to 6 percent slopes, severely eroded	Wd	VIe
Windom fine sandy loam, 0 to 2 percent slopes	We	I
Windom fine sandy loam, 2 to 6 percent slopes	Wf	IIIe
Windom loam, 0 to 2 percent slopes	Wg	I
Windom loam, 2 to 6 percent slopes	Wh	IIIe
Windom loamy fine sand, sandy substratum variant, 0 to 2 percent slopes	Wk	IIIe
Windom loamy fine sand, sandy substratum variant, 2 to 6 percent slopes	Wl	IIIe
Yordy loam, 2 to 6 percent slopes	Ya	IVe
Yordy loam, shallow phase, 2 to 6 percent slopes	Yb	IVe
Yordy loam, 6 to 12 percent slopes	Yc	VIe
Yordy loam, shallow phase, 6 to 12 percent slopes	Yd	VIe
Yordy silty clay loam, 2 to 6 percent slopes, eroded	Ye	IVe
Yordy silty clay loam, shallow phase, 2 to 6 percent slopes, eroded	Yf	IVe

MORPHOLOGY AND GENESIS OF SOILS

FACTORS OF SOIL FORMATION

Soils are formed by the forces of the environment acting upon soil materials deposited or accumulated by geological agencies. The characteristics of a soil at any particular place are determined by (1) the climate under which the soil material has accumulated and has existed since accumulation; (2) the physical and mineralogical composition of the parent material; (3) the relief, or lay of the land, which influences drainage, moisture content, aeration, susceptibility to erosion, and exposure to sun and the elements; (4) the biological forces acting upon the soil material—the plants and animals living in and on the soil; and (5) the length of time the climate and biological forces have acted upon the soil material.

CLIMATE

Climate influences both the physical and chemical weathering processes and the biological forces at work in the soil material. Generally, the soil-forming processes become more active as the soil warms, if adequate moisture is present, but they are limited by either inadequate or excess moisture.

The soils of Saline County have developed under a subhumid climate. Summers are hot and winters are moderately cold. The annual range in temperature is relatively large, and changes in temperature are often abrupt. The average precipitation at Salina is 27.17 inches, nearly 70 percent of which falls during the frost-free period. The 20-inch isoline showing average warm season (April through September) precipitation roughly divides the county into eastern and western halves, a moist subhumid eastern section and a dry subhumid western section. In seasonal distribution, precipitation is greatest during the early part of the growing season and decreases during the hot summer months. During the summer months the rate of evaporation is high and the relative humidity is lower than during any other season.

Soil-forming processes under these climatic conditions should be active at least 8 months of each year. In well-drained areas the physical, chemical, and biological forces are most active during May, June, July, and August, at which time the soils are both warm and moist. The processes at work in the soil are retarded during the months of March and April by low soil temperatures and during the months of September, October, and November by lower moisture content and lower temperatures. Minimum activity may be expected during December, January, and February.

In poorly drained areas both the type of activity and amount of activity may vary from that occurring in well-drained areas. In some of the fine-textured soils of the bottom lands plant residues decay less rapidly during April and May. Then, when the soil warms up, bacteria and plants compete for the nitrogen that becomes available. In some poorly drained areas, the bacteria may not reach maximum activity until the activity of those in well-drained soils has started to decline.

The transitional character of the climate between moist subhumid and dry types and the effect of this type of climate upon soils may be seen in the degree of leaching that has occurred. In some soils leaching has completely removed the calcium carbonate. In others the calcium carbonate has not been completely removed but has been carried downward to form a horizon of lime enrichment near the base of the solum. Further evidence of the effect of the transitional climate in the county is the lack of any uniform distribution of soils that have or do not have discernible horizons of lime enrichment.

Changes in the intensity of leaching probably are seasonal, and the total effect likely varies from year to year. In winter, leaching is slowed by low temperatures and freezing. In spring and early summer, the period of greatest rainfall, moderate temperatures, relatively high average humidity, and percolation of water

favor intense leaching. Late in summer and in early fall, high temperatures, low rainfall, and low humidity favor weathering of the soils but only incomplete leaching. Since this last-named condition exists somewhat longer than the others, incomplete leaching should be somewhat dominant. Growing plants, with their large demand for water, slow leaching to some extent during the season when it would be most active.

VEGETATION AND BIOLOGIC ACTIVITY

The original plant cover in Saline County consisted of a mixture of short and mid grasses. The tall grasses were predominant on the bottom lands. Today, the principal plant cover on many range areas is short grasses. Scattered areas of tall grass occur where grazing has been less intense. This vegetative cover has influenced soil development. Roots bring bases from lower layers, and when the plant dies these are returned to the upper layers in the organic matter. Thus, vegetation offsets the leaching process.

The organic carbon content of surface soils in virgin areas generally is in excess of 2 percent and in some well-drained upland areas is as high as 4 percent. The organic content, however, is not so high as that in more northern grassland areas where temperatures are lower and summers are shorter.

Generally, soils of bottom lands and terraces have a moisture supply that permits vigorous plant growth for a longer period each year. The greater volume of plant residues therefore collects, and if the soils are old enough to have distinct layers, this is reflected in their higher organic-carbon content and darker color. Youthful alluvial soils have not been in place long enough to accumulate organic matter from plants growing on them. If they contain much organic matter, it was in the sediments when they were deposited. In similar manner, moisture supply affects the organic-carbon content of upland soils. The content is greatest in level or concave areas where moisture favors heavier vegetative growth late in summer when the supply of moisture elsewhere is low.

The organic-carbon content of most soils in the county is relatively high to depths of about 16 inches or in that portion of the soil profile in which most of the plant roots grow. The greater organic-carbon content in the surface layer represents the accumulation of plant residues from both roots and vegetative litter above ground.

Although little information is available concerning biologic activity in the soils, the effects of such activity are evident. The uniform rate of decomposition caused by micro-organisms within soils of Saline County is shown by their nearly constant carbon-nitrogen ratio (table 12). Although most of the micro-organisms are aerobic, anaerobic types are present and may predominate in some of the poorly drained soils during some months of the year.

In the poorly drained soils the decomposition of plant residues by anaerobic bacteria proceeds slowly, is often incomplete, and the organic compounds are different from those formed in well-drained soils. The poorly drained soils are usually black and contain only partially decomposed organic material. Their organic-matter content may not be any higher than that in areas that receive less favorable supplies of plant residues. Nitrogen-fixing bacteria are less active in soils that have acid reactions and may be absent in poorly drained soils.

The plant cover has also influenced the physical and chemical characteristics of the soils. Grasses replenish surface soil horizons with basic elements, which offset the effect of soil leaching, keep the exchange complex nearly base saturated, prevent the soil from becoming too acid, and promote favorable physical conditions in the soil.

Earthworms are effective in improving tilth and insuring good soil aeration, and burrowing animals mix the soil and plant residues near their burrows.

AGE OR TIME

The length of time climate and biological forces have acted upon the soil materials is often difficult to determine. This difficulty arises because some soils develop more rapidly than others. As a result, an immaturely developed soil may have the same age as one that is maturely developed. Despite these disadvantages, the comparative age of most soils can be estimated from the geologic history of their parent materials, particularly the relative dates at which these materials were exposed or deposited.

In reconstructing the geologic history of the area, geologists had to study the rock formations and rock materials, their stratigraphic sequence, composition, and other characteristics, and their physiographic expression. From these, they determined the series of events which produced the present landscape and established the relative time of the events.

Table 8 lists, according to position, the rock formations that are exposed at the surface or that underlie Saline County.[7] The youngest members are uppermost and the older members lowermost in the sequence. Thin deposits of more recent age cap these formations in some areas. Since the youngest members in the sequence are exposed first, a relative time sequence can be established for soils that are developing residually from the rock formations. It must be remembered, however, that the rate of erosion varies; thus, older strata may be exposed in some places before younger strata are exposed in adjacent areas. Where residual soils are developing on the same formation, the time factor usually is indicated by depth to which the parent rock has been weathered or converted to soil.

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[7] Moore, Raymond C., Frye, John C., Jewett, J. M., and others. THE KANSAS ROCK COLUMN. Univ. of Kansas publications, State Geological Survey of Kansas Bul. 89, 132 pp., illus. 1951.

TABLE 8.—*Relative position and age of rocks that crop out or underlie Saline County*[1]

System	Series	Group	Formation	Member
Cretaceous	Gulfian		Dakota	Janssen clay. Terra Cotta clay.
	Comanchean		Kiowa shale; Cheyenne sandstone	
Permian	Leonardian	Sumner	Ninnescah shale; Wellington shale	

[1] Source: THE KANSAS ROCK COLUMN (see footnote, p. 148).

The age of alluvial and colluvial deposits along the streams and foot slopes varies greatly. Generally the alluvial deposits decrease in age from east to west, or traveling upstream toward the source of the deposits. The age of colluvial deposits can be judged by their depth and rate of deposition in a particular area.

The age of soils developed in loess parent material varies with the age of the deposits and, in some instances, the length of time loess deposits have been exposed. Wind-laid silts and clays were deposited in Saline County during two distinctly different periods. Sufficient time separated the two deposits to allow soil to develop on the original Loveland loess surface prior to the deposition of Peorian loess. Consequently, soils in Peorian loess materials overlie buried soils developed in Loveland loess deposits in some localities. In deep cuts the buried soil can be seen separating the two deposits.

Since the older Loveland loess was covered and had to be exposed before the present soils could develop in it, soils in the Loveland deposits usually are younger than those in the more recent Peorian deposits. Where Loveland deposits were never covered, or only thinly covered, soils developing on them are of greater age than those developed in Peorian loess.

The age relationship between soils developing in loess and those developing residually on bedrock is difficult to determine. Loess soils are sometimes older and sometimes younger than those developing from bedrock. It is believed, however, that residual soils on formations of Cretaceous age are generally older than those developing on either of the loess sheets.

The youngest soils in the area are on the present flood plain and terraces and those developing in loess deposits that mantle the uplands east of the Smoky Hill River.

Several characteristics of soils in relation to parent materials were observed in correlating their relative ages. Probably the most noticeable relationships are the greater number of claypan soils that have developed in materials of older age and the greater variety of soils that occur on these materials.

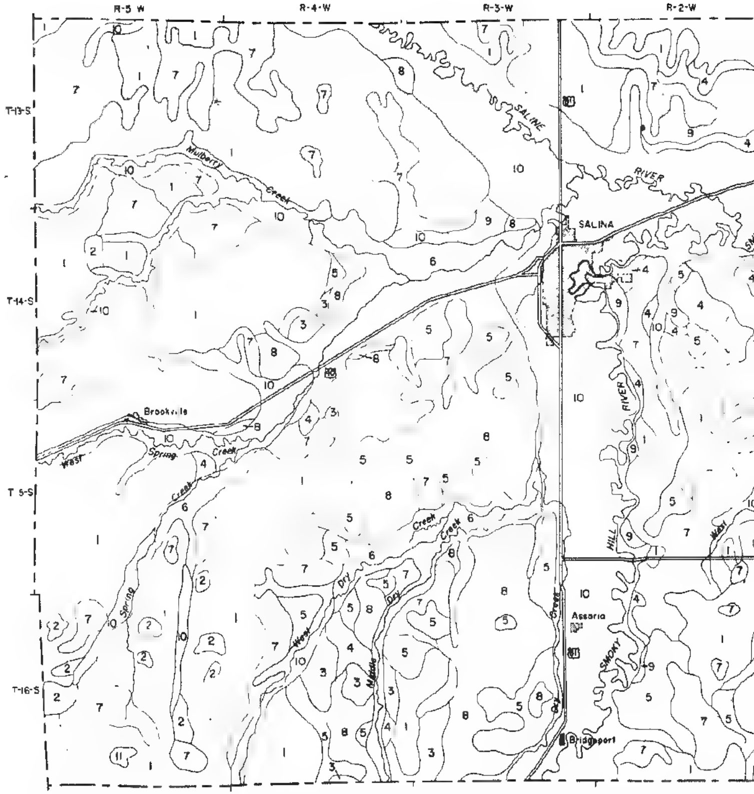

Figure 2.—Generalized map of parent materials for soils of S

PARENT MATERIALS

Eleven major kinds of parent materials were recognized during the soil survey of Saline County. The distribution of these materials is shown on the generalized map of parent materials (fig. 2). The soil series occurring on each type of parent material are listed in the explanation to figure 2.

Explanation of figure 2

Group No.	Parent materials	Soil series
1	Weathered sandstones and shales of Dakota formation.	Cloud, Edalgo, Englund, Hedville, Lancaster, Westfall.
2	Weathered Terra Cotta shales	Lanham, Tescott.
3	Weathered clay shales and limestones of the Ninnescah formation.	Malmgren, Ninnescah, Rentide, Vernon.
4	Weathered clay shales and limestones of the Wellington formation.	Assaria, Idana, Kipp, Kipson.
5	Weathered fill and outwash of pre-Loveland age modified by Loveland loess.	Benfield, Elmo, Hallville, Longford, Smolan, Yordy.
6	Weathered alluvium and loess of Loveland age (high terraces).	Albion, Bonaccord, Elmo terrace phase, Langley, Rokeby, Salemsburg, Stimmel.
7	Weathered loess of Peorian age.	Berg, Ebenezer, Niles.
8	Weathered terrace deposits and loess of Peorian age.	Lindsborg, Lockhard, McPherson.
9	Weathered loess of recent age	Geary, Pratt, Shellabarger.
10	Weathered alluvial deposits on present terraces and flood plains.	Arkansas, Detroit, Falun, Fore, Hall, Hobbs, Humbarger, Lincoln, Marydel, Muir, New Cambria, Roxbury, Smoky Butte, Solomon, Sutphen, Tobin, Wabash, Windom.
11	Weathered Tertiary outwash deposits.	Carlson.

Generally the properties inherited from parent materials are most pronounced in the younger soils. As the soil-forming processes continue over longer periods of time, both the physical and chemical characteristics of the soil are changed. In the more mature soils, many of the inherited characteristics have been greatly altered or are no longer present. For example, the Vernon series, which is developing in weathered shales of the Ninnescah formation, is strongly calcareous in reaction and brilliant red in color. It is like its parent material. The moderately shallow phase of the Rentide soil series, however, is more mature. Although it is developing on the same parent shale material, it is less calcareous in reaction and has surface and subsoil horizons

that are less brilliant in color. The mature Rentide soils have surface soils that are neutral to slightly acid in reaction and less red than the moderately shallow Rentide soil.

The eleven major kinds of parent materials are discussed in the following pages. In some of the groups, particularly where the parent materials consist of alluvial deposits, further subdivisions have been made to account for differences in texture, age, and source of the material.

1. *Weathered sandstones and shales of Dakota formation.*—These materials have been weathered residually from interbedded clay shales, siltstones, loamstones, and fine-grained sandstones of Cretaceous age. Some of the weathered material occurs locally as colluvial and alluvial wash along lower foot slopes. The material is yellowish red, reddish brown, or olive gray in color; is neutral to slightly alkaline in reaction; and varies from fine sandy loam to sandy clay in texture. Color and texture of the residual material vary according to the relative amounts of clay shale and sandstone in the material. The thickness of the material varies, from a few inches on the crests of hills to 12 or more feet along foot slopes. Partially weathered material often contains coarse fragments of sandstone and ironstone. Illite and montmorillonite are the dominant clay minerals. In a few scattered locations the parent strata are associated with calcareous beds of Permian age.

2. *Weathered Terra Cotta shales.*—These materials weathered residually from Cretaceous clay shales. The parent material has a mottled red and gray appearance that gradually becomes uniformly red as weathering continues. The weathered material is slightly alkaline in reaction and uniformly clay or silty clay in texture, but it lacks the plasticity commonly associated with these textures. The thickness rarely exceeds 4 feet and usually is about 2 feet or less. Many pellets and concretions of ironstone are present. The dominant clay mineral is kaolinite.

3. *Weathered clay shales and limestones of the Ninnescah formation.*—These materials have been weathered residually from red- and olive-colored clay shales and limestones of Permian age. Some of the weathered material occurs locally as colluvial and alluvial wash along the lower foot slopes. The materials are reddish brown to brownish red in color; calcareous in reaction; and silty clay loam or silty clay in texture. They vary from a few inches to 6 feet or more in thickness over the bedrock strata and are very plastic when wet.

4. *Weathered clay shales and limestones of the Wellington formation.*—These materials have been weathered residually from strongly calcareous, gray clay shales and interbedded limestone of Permian age. Some of the weathered material occurs locally as alluvial and colluvial wash along the lower foot slopes. The materials are a grayish brown to olive; very strongly calcareous; and silty clay loam or silty clay in texture. In thickness of materials they vary from a few inches on the crests of steep ridges to 4 or 5 feet on the lower foot slopes.

5. *Weathered fill and outwash of pre-Loveland age modified by Loveland loess.*—These parent materials have their greatest extent in the central and eastern part of the county. They occupy

the uplands, but locally some of the material occurs as colluvium along lower foot slopes. They are believed to have originated, in part as outwash, upon which windborne silts of Loveland age (Sangamon interglacial period) were deposited. Since they have inherited their present characteristics from the loess, they are considered to be Loveland deposits.

Loveland deposits on the terraces and flood plains have undergone greater mixing with alluvium and are weathered in a slightly different manner. For this reason they are discussed as a separate type of parent material in group 6.

Soils have developed on these early loess deposits of the upland only where the deposits were not covered by later deposits or where the overlying cover has been removed by erosion. The original character of these deposits has been greatly modified by mixing with coarse ironstone and sandstone fragments and other weathered bedrock materials. The degree of modification varies with topographic position. Greater mixing has occurred in actively eroding areas.

These weathered upland deposits have a reddish-brown color that clearly distinguishes them from the later Peorian loess deposits that overlie them. They are alkaline in reaction and usually calcareous, but they do not contain the amounts of free calcium carbonate usually found in the more recent loess deposits. They are silty clay loam in texture, but sometimes contain a small percentage of fine sand. Ironstone and sandstone fragments are usually present and in some areas are concentrated in old drainage channels to form open gravel beds. In thickness, the Loveland beds vary from a few inches to more than 10 feet.

6. *Weathered alluvium and loess of Loveland age.*—These materials are on the terraces and flood plains of old stream valleys in the central and eastern part of the county. They are composed of alluvium and loess and, according to age and kind of material, may be considered as three types.

The first type consists of mixed alluvial and windborne deposits on high terraces along Mulberry, Spring, Dry, and Gypsum Creeks. These terraces were formed during the period when Loveland loess was deposited. The materials are pale brown or yellowish brown in color and neutral to alkaline; they contain many large, distinct, yellowish-red mottles and generally are uniformly silty clay loam in texture. In some areas they include strata of loam and fine sandy loam. The beds vary from 5 to 20 feet or more in thickness, are indistinctly stratified, and contain large concretions of calcium carbonate. In some areas these materials were covered by Peorian loess deposits and then exposed by erosion. In other areas they were never covered. The Bonaccord, Langley, and Stimmel soil series developed on these materials.

The second type consists of materials that are younger and have been influenced less by loess deposits. These materials are on high terrace positions along the Smoky Hill River and Gypsum Creek. The deposits on the high terraces near Salina are yellowish brown in color, calcareous, sandy and gravelly in texture, and 20 feet or more thick. Near the town of Gypsum, the deposits are yellowish brown in color and neutral to slightly alkaline in

reaction. They have heavy fine sandy clay loam textures and are generally 15 feet or more in thickness. Albion soils and the terrace phases of the Elmo series developed on these materials.

The third type consists of reworked alluvial and loess deposits. These uniformly silty materials occur on the terraces along Dry Creek and its tributary branches. They are probably younger than the two types already described, but older than the deposits on present flood plains and low terraces. The Rokeby and Salemsburg soil series have developed in these materials.

7. *Weathered loess of Peorian age* (uplands).—These windborne silts were deposited on the uplands during the interval between the Iowan and Wisconsin glacial stages. They are uniform in texture and form an unevenly distributed blanket 3 to 6 feet in thickness. Since they were deposited, the materials have been weathered, reworked, and redistributed by erosion. Where the loess deposits have been mixed with alluvial deposits on terraces and flood plains, the type of weathering has differed. The latter deposits are treated as a separate type of parent material in group 7.

The parent materials discussed in this group are uniformly yellowish brown in color, calcareous, and usually uniformly of silty clay loam texture. They rest on the underlying rock, on Loveland loess deposits, or on soils that developed on weathered bedrock and loess materials laid down before the Peorian loess. The buried soils often form a distinct boundary between the Peorian loess deposits and the older Loveland loess deposits and, where present, often affect subsoil drainage and soil development.

8. *Weathered terrace deposits and loess of Peorian age.*—These materials were deposited on broad terraces in the central part of the county at the same time the upland deposits described in group 7 were laid down. After they were deposited, prolonged poor drainage, and possibly inundation, followed.[8]

The materials have very uniform silty clay textures and olive-gray colors. They are strongly calcareous and contain nodules of accumulated calcium carbonate. They vary from 4 to 8 feet in thickness and when cut by deep excavations display strong vertical cleavage (pl. 4, *A*).

9. *Weathered loess of recent age.*—These deposits form a thin mantle on the upland slopes bordering the large river valleys of central and eastern Kansas. They are composed of fine materials picked up from the flood plains of the major streams. In some localities they assume dunelike landforms on the terraces.

The materials vary in texture from silty clay loam to loamy fine sand, but in any given location textures are uniform. The materials are yellowish brown to reddish yellow and range from 4 to 20 feet or more in thickness. Their reaction varies from strongly alkaline to slightly acid, depending upon the source of the materials.

10. *Weathered alluvial deposits on present terraces and flood plains.*—These are the most widespread parent materials in the county. They are developing in recent sediments and are ex-

[8] Fent, O. S. PLEISTOCENE DRAINAGE HISTORY OF CENTRAL KANSAS. Kansas Academy of Science, Vol. 53, No. 1, 599 pp., 1950.

tremely variable in texture, color, and reaction (pl. 4, *B*). Their texture closely correlates with the velocities of the transporting streams. Their color and reaction depend largely upon characteristics of the source from which they were carried.

Along the larger streams of the county the deposits are calcareous and grayish brown to yellowish brown. They vary from loamy fine sands to clays and generally become more sandy near the stream. They are 30 feet or more in thickness.

Along the smaller streams in the western part of the county the deposits are yellowish brown in color and neutral to slightly alkaline in reaction. They contain more sandy materials than the deposits along the large streams. Along the smaller streams in the eastern part of the county the deposits are more uniformly silts to clays. They are neutral to calcareous in reaction and grayish brown in color.

11. *Weathered Tertiary outwash deposits.*—These materials occur in the southwestern part of the county as remnants of Tertiary deposits washed from higher areas to the west. They are yellowish brown to grayish brown, moderately fine textured, and strongly calcareous. In places they contain soft marl and caliche beds.

RELIEF

Relief is a soil-forming factor that influences the development of soil in relatively small areas, chiefly by controlling the movement of water on the surface. Thus, each soil type usually can be associated with certain relief characteristics, such as degree of slope or shape of the surface. Together with soil permeability, relief controls the runoff, drainage, and moisture characteristics of the soil.

The importance of relief in the development of soils in Saline County is best illustrated by several examples. The amount of moisture entering Lancaster loam on 8 percent slopes is much less than that which enters Westfall silt loam on 2 percent slopes, although the permeability characteristics of both soils are the same. Berg silt loam occurs on a 3 percent slope of convex shape, but it receives less runoff than Niles silt loam on the same degree of slope because the Niles soil has a concave slope where water tends to accumulate. It is also possible for the same soil to develop in areas having different topographic characteristics, provided the effect of relief in controlling soil moisture is the same. For instance, Niles silt loam occurs (1) in the concave heads of drainageways and (2) on broad, nearly level to gently sloping flats. The same soil develops in these places because, in both, there is more than the normal amount of moisture. At heads of drainageways, the runoff accumulates on the concave surface of the soil, and on the flats the rate of runoff is reduced.

Relief also is very important where steep slopes cause rapid runoff. Little water can penetrate the soil to influence soil-forming processes, and the surface soil may be removed through erosion. Under these conditions, very thin and immature soils develop.

The relationship between soils and relief is shown in table 9. Soil series having the same parent material are listed on the

TABLE 9.—*Parent material and relief*

Parent material	Landform and slo			
	Convex and simple slopes			C
	Steep	Medium	Gentle	Flat
Cretaceous sandstones and sandy shales.	Hedville	Lancaster	Westfall	
Cretaceous clay shales	Cloud	Edalgo	Englund	
Cretaceous kaolonitic clay shales	Lanham	Lanham	Tescott	
Permian calcareous gray shales and limestones.	Kipson	Kipp	Idana	
Permian calcareous red clay shales	Vernon	Rentide, moderately shallow phase.	Rentide	
Alluvium and colluvium from Permian red shales and limestones.		Ninnescah	Ninnescah	
Gravel and channery outwash and silts of Loveland age or older.	Hallville	Yordy	Yordy	
Loveland silts	Elmo	Longford	Smolan	
Colluvium and silts of Loveland age or older over Permian shales and limestones.	Benfield shallow phase.	Benfield		
Peorian loess deposits		Berg	Ebenezer	Niles
Peorian loess deposited under poor drainage conditions.			Lockhard	McPherson
Recent silty loess	Geary	Geary		
Recent loamy loess	Shellabarger.	Shellabarger.		
Recent sandy loess	Pratt	Pratt		
Locally transported silty alluvial and colluvial materials.				

Locally transported sandy alluvial and colluvial materials.				
Strongly calcareous outwash materials			Carlson	
Silty alluvium and loess of early Loveland age.			Langley	Bonaccord
Silty alluvium and loess of late Loveland age.		Elmo, terrace phase.	Elmo, terrace phase.	
Sandy alluvium and loess of late Loveland age.		Albion		
Reworked silty alluvium and loess of Loveland age.			Salemsburg	Rokeby

same horizontal line. Those having the same landform and slope are listed in the same vertical column. Where the same soil series occurs on more than one category of landform and slope, the series name is shown under each category. The influence of relief in the development of Saline County soils is most pronounced where soils have developed on the same parent materials but are different in profile characteristics because of differences in relief (pl. 3, *B*). Such a group is called a "catena", or toposequence. Soil series listed on the same horizontal line in table 9 are members of the same catena.

Soils of the bottom lands and low terraces are not included in table 9. The effect of topography on these recent alluvial deposits is negligible, either because the surface is nearly level or because the deposits have been in place so short a time that relief has had little effect. Also, the flow of water in these soils is often controlled more by ground water movement and runoff from surrounding areas than it is by relief.

CLASSIFICATION OF THE SOILS

The soils of Saline County have been classified by order, suborder, great soil group, family, series, and type as shown in table 10. In this region the three major groups, or orders (zonal, intrazonal, and azonal soils) are each represented by one suborder. The zonal order is represented by two great soil groups, Chernozem and Brunizem (Prairie) soils; the intrazonal order by one great soil group, the Planosols; and the azonal order by three great soil groups, Lithosols, Regosols, and Alluvial soils.

The great soil groups in this report are placed in families according to the degree to which genetic horizons are expressed or according to the presence of subhorizons that indicate gradation to other great soil groups. The name given to the family is taken from the soil series that is most characteristic of the central concept of the family.

Each family is subdivided into soil series on the basis of differences in parent material and associated minor differences in the profile. Series, in turn, are subdivided into types on the basis of texture of the surface soil, and finally the types are subdivided into phases on the basis of depth, slope, degree of erosion, and other characteristics that are not strictly properties of the soil but are important problems in land use and management.

CHERNOZEM SOILS

In this great soil group are dark-colored grassland soils with A, A-B, B, B-C, C_{ca}, and C horizons. The B-C or C horizons are characterized by distinct layers of lime accumulations. These soils have developed on a variety of parent materials in both upland and bottom land areas.

Plants on these soils return large amounts of organic matter and basic elements to the surface layers annually. The bases, particularly calcium carbonate, are then carried downward through the soil by percolating ground water. The rainfall, however, is not sufficient to completely leach the bases from the soil. Instead, the bases accumulate in the lower horizons. This return

TABLE 10.—*Classification of soils*

ZONAL SOILS

Dark-colored soils of subhumid grasslands

Great soil group and family	Series	Type
Chernozem soils:		
Kipp	Carlson	Carlson silty clay loam.
	Kipp	Kipp silt loam.
		Kipp silty clay loam.
	Roxbury	Roxbury silty clay loam.
Detroit	Detroit	Detroit silt loam.
		Detroit silty clay loam.
		Detroit silt loam, overwash phase.
		Detroit loamy fine sand, overwash phase.
	Hall	Hall silt loam.
		Hall silt loam, brown subsoil variant.
	Idana	Idana silt loam.
		Idana silty clay loam.
	Ninnescah	Ninnescah silt loam.
Berg	Benfield	Benfield silty clay loam.
		Benfield silty clay loam, shallow phase.
	Berg	Berg silt loam.
		Berg silty clay loam.
	Rentide	Rentide silt loam.
		Rentide silty clay loam.
		Rentide silt loam, moderately shallow phase.
	Smolan	Smolan silt loam.
Ebenezer-Lockhard	Assaria	Assaria silt loam.
		Assaria silty clay loam.
	Ebenezer	Ebenezer loam.
		Ebenezer silt loam.
		Ebenezer silty clay loam.
		Ebenezer silt loam, colluvial phase.
	Englund	Englund silt loam.
		Englund silty clay loam, very shallow variant.
	Lockhard	Lockhard silt loam.
		Lockhard loamy fine sand, overblown phase.
	McPherson	McPherson silt loam.
	Niles	Niles silt loam.
		Niles silty clay loam.
	Rokeby	Rokeby silt loam.
Prairie soils:		
Edalgo-Muir	Edalgo	Edalgo silt loam.
	Lanham	Lanham silt loam.
	Muir	Muir silt loam.
	Smoky Butte	Smoky Butte silt loam.
	Tobin	Tobin silt loam.
Lancaster	Albion	Albion loam.
		Albion coarse sandy loam, shallow phase.
	Elmo	Elmo silt loam.
		Elmo silty clay loam.
		Elmo silt loam, terrace phase.
		Elmo loam, terrace phase.

TABLE 10.—*Classification of soils*—Continued

Great soil group and family	Series	Type
	Geary	Geary silt loam.
	Lancaster	Lancaster loam. Lancaster loam, shallow phase. Lancaster fine sandy loam. Lancaster fine sandy loam, shallow phase.
	Langley	Langley silt loam. Langley silty clay loam.
	Marydel	Marydel silt loam. Marydel loam, poorly drained variant. Marydel fine sandy loam. Marydel loamy fine sand.
	Pratt	Pratt fine sandy loam.
	Salemsburg	Salemsburg silt loam.
	Shellabarger	Shellabarger loam. Shellabarger fine sandy loam. Shellabarger silt loam.
	Windom	Windom loam. Windom fine sandy loam. Windom loamy fine sand, sandy substratum variant.
	Yordy	Yordy loam. Yordy silty clay loam. Yordy loam, shallow phase. Yordy silty clay loam, shallow phase.
Westfall	Longford	Longford silt loam. Longford silty clay loam.
	Tescott	Tescott silt loam. Tescott silty clay loam.
	Westfall	Westfall silt loam. Westfall silty clay loam.
Bonaccord	Bonaccord	Bonaccord silty clay loam.
	Malmgren	Malmgren silt loam.
INTRAZONAL SOILS Hydromorphic soils of depressions and flats		
Planosols:		
Lindsborg	Lindsborg	Lindsborg silt loam.
	Stimmel	Stimmel silt loam. Stimmel silty clay loam.
AZONAL SOILS Undeveloped or weakly developed grassland soils of uplands and flood plains		
Lithosols:		
Hedville	Cloud	Cloud silty clay loam.
	Hedville	Hedville loam. Hedville stony loam.
	Kipson	Kipson silt loam. Kipson shaly silt loam.
	Vernon	Vernon silty clay loam.
Regosols:		
Hallville	Hallville	Hallville loam. Hallville loam, shallow phase.

TABLE 10.—*Classification of soils*—Continued

Great soil group and family	Series	Type
Alluvial soils:		
Humbarger	Arkansas	Arkansas fine sandy loam.
	Falun	Falun fine sandy loam.
	Fore	Fore silty clay loam, deep over silt.
	Hobbs	Hobbs silt loam.
		Hobbs silt loam, light-colored variant.
	Humbarger	Humbarger silt loam.
		Humbarger loam.
	Lincoln	Lincoln loamy fine sand.
	New Cambria	New Cambria silty clay loam.
Fore	Fore	Fore clay.
Sutphen	Solomon	Solomon clay.
		Solomon clay, low lime variant.
	Sutphen	Sutphen silty clay.
	Wabash	Wabash silty clay loam.

of bases to the surface layers by plants opposes their accumulation in the lower part of the soil profile and produces soils that are nearly neutral throughout and nearly base saturated.

The Chernozem soils of Saline County are not so well developed as the Chernozem soils farther north. Some of the Chernozems in Saline County have characteristics that are not modal for the great soil group as a whole. In general they have lighter colored surface soils and contain less organic matter. For these gradational soils, chromas are rarely less than 2, organic carbon content rarely exceeds 2.5 percent, and organic materials are not distributed to as great a depth in the solum as in modal Chernozems. The layer of lime accumulation is weakly expressed and occurs at greater depths than in the more northern Chernozem soils. Leaching is more complete, and many of the soils are moderately to slightly acid.

The Chernozem soils are concentrated in the more humid eastern part of the county, and the Brunizem, or Prairie, soils are in the western part. This distribution is opposite to what would occur if rainfall were the dominant factor in their development.

Since the Chernozem soils have developed from calcareous parent materials, and the Brunizem soils from noncalcareous parent materials, it appears that parent materials, or factors that locally control soil moisture, are more important than rainfall in the development of the two soil groups.

Chernozem soils in this county are in four families and have profiles that are (1) modal, or normal; (2) weakly expressed; (3) strongly expressed; or (4) somewhat like profiles of another great soil group.

KIPP FAMILY

This family includes the Carlson, Kipp, and Roxbury soil series. The members of these series have individual soil horizons that are weakly expressed. There is very little clay accumulation in their B horizons. The B horizon is identified for the most part by its

TABLE 11.—*Mechanical analyses, pH, and organic-carbon content determinations for five soils of Saline County*

Horizon	Depth	pH of saturated paste	Size class and diameter of particles (in mm.)							Organic carbon
			Very coarse sand (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.5–0.25)	Fine sand (0.25–0.1)	Very fine sand (0.1–0.05)	Silt (0.05–0.002)	Clay (<0.002)	
	Inches		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Kipp silt loam:										
A_1	0–4	7.1	0.3	0.5	1.0	2.8	4.4	62.1	28.9	2.79
A–B	4–12	6.6	.2	.2	.9	2.4	4.2	57.5	34.6	1.86
B_2	12–20	7.0	.1	.2	.7	1.8	3.0	53.1	41.1	1.48
B_{3ca}	20–24	7.9	2.2	1.8	1.0	1.9	2.1	53.4	37.6	.97
C	24–30	7.9	1.6	1.6	.9	1.5	1.5	58.1	34.8	.79
Berg silt loam:										
A_1	0–6	5.8	.0	.1	.4	1.1	7.1	65.7	25.6	1.16
A–B	6–16	6.2	.0	.1	.2	.4	3.2	55.9	40.2	1.05
B_{21}	16–22	6 8	.1	.1	.2	.4	2.3	53.3	43.6	.60
B_{22}	22 30	7.2	.0	.1	.1	.4	2.1	54.7	42.6	.75
B_{3ca}	30–38	7.7	.5	.5	.3	.6	2.3	55.6	40.2	.45
C_1	38–50	7.8	.7	.5	.5	.9	2.5	57.4	37.5	.33
C_2	50–90	7.8	.3	.3	.4	1.0	3.9	57.5	36.6	.26
Edalgo loam:										
A_1	0–6	5.6	.6	1.2	3.3	11.1	11.2	47.7	24.9	1.78
B_1	6–16	5.8	.9	1.4	3.3	9.2	8.6	42.1	34.5	1.54
B_2	16–22	6.3	2.7	2.1	2.5	6.0	4.4	29.1	53.2	.94
C	22–36	7.4	.2	.1	.2	.3	.5	50.5	48.2	.40
Westfall silt loam:										
A_1	0–6	5.6	.2	2.0	4.0	8.1	9.9	52.6	23.2	2.60
A–B	6–15	5.8	.2	1.5	3.2	6.6	9.3	43.4	35.8	1.60
B_{21}	15–22	6.1	.2	1.8	2.7	5.4	6.9	42.2	40.8	1.10
B_{22}	22–30	6.8	.2	1.9	3.0	6.2	8.3	41.0	39.4	.85
B_3	30–38	7.8	.8	2.2	3.2	6.7	9.0	41.7	36.4	.50
C	38–48	7.8	1.4	2.4	3.4	6.9	8.8	42.3	34.8	.30
Bonaccord silty clay loam:										
A_1	0–6	6.1	.0	.1	.1	.5	3.1	56.4	39.8	1.53
B_1	6–16	6.2	.0	.1	.2	.6	3.4	53.0	42.7	1.25
B_2	16 24	6.3	.0	.1	.2	.5	4.2	53.1	41.9	.80
B_3	24–36	6.4	.0	.1	.1	.5	5.2	55.0	39.1	.50
C_1	36–48	7.2	.1	.3	.2	1.0	5.2	60.8	32.4	.38

color, structure, and consistence. The layer of lime accumulation, although present, is not always clearly distinguishable from the parent material. Mechanical analyses, pH, and organic-carbon content determinations for Kipp silt loam are given in table 11.

Profile description of Kipp silt loam:

A_1 0 to 4 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) silt loam; soft when dry, friable when moist; weak fine granular structure; approximately neutral in reaction; 3 to 7 inches thick; lower boundary clear and smooth.

A-B 4 to 12 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; strong fine and very fine granular structure; approximately neutral in reaction; 6 to 10 inches thick; lower boundary clear and smooth.

B_2 12 to 20 inches, light olive-brown (2.5Y 5/3, dry) to olive-brown (2.5Y 4/3, moist) silty clay loam; hard when dry, friable when moist; moderate very fine subangular blocky structure; approximately neutral in reaction; 6 to 12 inches thick; lower boundary gradual and smooth.

B_{3ca} 20 to 24 inches, light olive-brown (2.5Y 5/4, dry) to olive-brown (2.5Y 4/4, moist) silty clay loam; hard when dry, friable when moist; massive to very weak fine subangular blocky structure; calcareous; contains a few small concretions and mycelia of calcium carbonate; 4 to 8 inches thick; lower boundary gradual and smooth.

C_1 24 to 30 inches, pale-yellow (5Y 7/3, dry) to olive (5Y 5/3, moist) silty clay or silty clay loam; very hard when dry, very plastic when wet; calcareous; massive; this horizon principally partially weathered shale; 5 to 12 inches thick.

Dr 30 inches +, conspicuously mottled olive-yellow and yellowish-brown clayey shale; calcareous; many feet thick.

Detroit family

This family includes soils of the Detroit, Hall, Idana, and Ninnescah series. Members of these series have all the characteristics of Chernozem soils. Their moderately well developed B_2 horizons have finer textures than either the A or C horizons, and flow surfaces of silicate clay can be seen on the faces of soil aggregates in the B_2 horizon. All the horizons are more clearly defined than they are in soils of the Kipp family, and the horizon of lime accumulation is thicker and more pronounced. As a family, these soils possess the modal, or normal, profile characteristics of the Chernozem great soil group.

Berg family

This family contains soils of the Benfield, Berg, Rentide, and Smolan series. All the soils of this family have well-developed Chernozem characteristics, including strongly developed B_2 horizons. The B_2 horizons, however, are distinctly finer textured than the same horizons in the soils of the Kipp and Detroit families, and flow surfaces of silicate clays are strongly developed on the soil aggregates. Individual soil horizons are clearly defined. The thickness of the solum generally does not exceed that of the Detroit family, and the zone of lime accumulation usually is not any more pronounced. Table 11 gives the mechanical analyses, pH, and organic-carbon determinations for a typical soil in this family.

Ebenezer-Lockhard family

This family includes the Assaria, Ebenezer, Englund, Lockhard, McPherson, Niles and Rokeby soil series. Soils in these series have all the characteristics common for Chernozems, but they also possess some characteristics of the Planosols. They are dark-colored grassland soils with strongly developed textural B_2 horizons. In addition, they show evidence of a very weakly developed A_2 horizon. The textural break between the incipient

TABLE 12.—*Physical and chemical characteristics of three soils sa*

[Determinations by Mandan, S. Dak., Soil Laboratory[1]; sample identification numbers sho

MECHANICAL ANALYSES

Horizon	Depth	Size class and diameter of particles (in mm.)					
		Very coarse sand (2.0–1.0)	Coarse sand (1.0–0.5)	Medium sand (0.5–0.25)	Fine sand (0.25–0.1)	Very fine sand (0.1–0.05)	Silt (0.05–0
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Perce*
Ebenezer silt loam (1394–1403):							
A_{11}	0–2	0.1	0.2	0.9	4.3	8.0	6
A_{12}	2–5	.2	.3	1.2	5.4	8.3	6
A_3	5–8½	.2	.3	1.1	5.0	6.4	5
B_1	8½ 11		.2	.7	3.1	4.8	5
B_{21}	11–21		.1	.3	.9	2.1	5
B_{22}	21–26	.9	.5	.4	.8	2.1	5
B_{3ca}	26–30	1.3	.4	.4	1.3	2.4	5
C_{1ca}	30–37	.3	.3	.6	4.0	4.7	6
C_{2ca}	37–43		.2	.9	7.5	7.7	5
C_{3ca}	43–60+	.3	.3	1.3	11.8	11.0	4
Lockhard silt loam (1377–1384):							
A_{1p}	0–6	.1	.2	.4	.8	7.0	6
A_{12}	6–10		.2	.2	.4	5.2	6
A–B	10–14		.1	.1	.3	2.9	4
B_{21}	14–19		.1	.1	.2	2.0	5
B_{22}	19–28		.1	.1	.2	1.8	4
B_{3ca}	28–40	1.1	.4	.2	.3	1.6	5
C_{ca}	40–45	.1	.3	.2	.2	1.2	5
C	45–60					2.0	6

Lancaster loam (1410–1415):							
A_{11}	0–4	.2	.6	8.1	23.3	8.3	4
A_{12}	4–9	.1	.5	8.5	24.4	8.6	3
A–B	9–13	.1	.5	8.3	23.1	8.7	3
B_2	13–19	.6	.6	8.7	23.9	9.1	3
B_3	19–27	.5	.7	9.9	27.8	10.8	3
C_1	27–37	.4	.8	10.5	29.9	11.8	3

CHEMICAL ANALYSES

Horizon	Depth	pH			Exchangeable cations (m.e./100 gm.)				Cation exchange capacity (m.e./100 gm.)	Organic carbon
		Saturated paste	1:5 soil-water suspension	1:10 soil-water suspension	Ca	Mg	Na	K		
										Percent
Ebenezer silt loam (1394–1403):										
A_{11}	0–2	5.9	6.2	6.3	13.1	4.7	0.1	1.5	22.5	3.14
A_{12}	2–5	5.7	5.9	6.0	12.8	4.5	.1	1.1	22.1	2.36
A_3	5–8½	5.9	6.1	6.3	12.7	5.3	.2	1.0	22.2	1.67
B_1	8½–11	6.0	6.3	6.4	14.8	7.7	1.0	1.1	25.7	1.27
B_{21}	11–21	6.4	6.9	7.0	20.2	12.5	2.2	.9	32.3	.74
B_{22}	21–26	7.7	8.6	8.8	36.6	12.0	3.6	.6	30.3	.51
B_{3ca}	26–30	7.9	8.6	8.7	31.4	11.5	5.0	.5	29.2	.36
C_{1ca}	30–37	7.6	8.5	8.6	23.7	8.9	4.7	.4	24.5	.21
C_{2ca}	37–43	7.3	7.4	7.3	46.3	6.1	3.7	.3	19.8	.13
C_{3ca}	43–60+	7.2	7.6	7.6	11.2	5.6	3.4	.2	17.6	.14

TABLE 12.—*Physical and chemical characteristics of three soils sampled*

CHEMICAL ANALYSES—Continued

Horizon	Depth	pH			Exchangeable cations (m.e./100 gm.)				Cation exchange capacity (m.e./100 gm.)	Organic carbon
		Saturated paste	1:5 soil-water suspension	1:10 soil-water suspension	Ca	Mg	Na	K		
										Percent
Lockhard silt loam (1377–1384):										
A_{1p}	0–6	5.6	5.8	5.9	10.2	3.3	.1	.8	17.5	1.16
A_{12}	6–10	5.8	6.0	6.1	14.7	4.9	.5	.6	23.9	1.11
A–B	10–14	6.0	6.4	6.6	21.4	7.7	1.1	.7	31.9	.84
B_{21}	14–19	6.3	6.7	7.0	23.4	8.2	1.3	.8	33.1	.61
B_{22}	19–28	7.0	7.4	7.5	23.8	9.1	1.9	.8	33.1	.49
B_{3ca}	28–40	7.5	8.3	8.4	42.3	9.2	2.3	.8	31.6	.27
C_{ca}	40–45	7.6	8.4	8.5	34.5	8.7	2.6	.7	30.7	.17
C	45–60	7.5	8.2	8.1	22.6	8.2	2.3	.6	28.4	.09
Lancaster loam (1410–1415):										
A_{11}	0–4	6.0	6.0	6.0	8.6	2.6	.1	.5	14.4	1.81
A_{12}	4–9	5.8	5.9	5.9	8.1	3.2	.1	.2	14.2	1.23
A–B	9–13	5.8	6.0	6.0	9.0	3.5	.1	.2	14.6	1.09
B_2	13 19	5.9	6.0	6.1	8.1	2.8	.1	.2	13.1	.70
B_3	19–27	6.3	6.4	6.4	6.7	2.2	.1	.1	9.4	.33
C_1	27–37	6.8	6.7	6.8	4.8	2.7	.1	.1	7.1	.18

[1] Records now at Soil Conservation Service Soil Laboratory, Lincoln, Nebr.

A_2 horizon and B_2 horizon is not so pronounced as in Planosols, but it is more abrupt than that between the A_1 and B_2 horizons of the other Chernozem families. Evidence of an A_2 horizon is restricted to strong gray coatings on soil aggregates immediately above the fine-textured B_2 horizon. The coating varies in amount within the soils of this family and is noticeable only in dry weather in most of the soils. The B_2 horizons in these soils usually are compact and hard, and they have a clay content in excess of 43 percent. They shrink and crack upon drying and tend to swell and become impermeable when wet. Analytical data for two representative soils in this family are given in table 12.

BRUNIZEM (PRAIRIE) SOILS

In this great soil group are dark-colored grassland soils with A, A-B, B, B-C, and C horizons. They lack distinct layers of lime accumulation in the lower B-C and C horizons, and they are distinguished from Chernozem soils principally on this basis. They have developed from a variety of parent materials in both upland and bottom-land areas. The parent materials, however, contain much less free calcium carbonate than the parent materials of Chernozem soils.

Plants return large amounts of organic matter and bases to these soils annually, but enough moisture is present to leach the soils and prevent lime accumulations in their lower horizons. The Brunizem soils of Saline County generally are not so acid as soils possessing the median characteristics of this great soil group. The content of organic carbon, too, is usually lower, but base saturation is somewhat greater, particularly in the lower part of the B horizon. In some areas of the county these soils may have some lime accumulation in the lower part of their profiles.

The Brunizem soils in Saline County have been placed in four families according to the degree of development of their major horizons.

EDALGO-MUIR FAMILY

In this family are soils of the Edalgo, Lanham, Muir, Smoky Butte, and Tobin series. The soils have only weakly expressed textural horizons. The B horizons are distinguished principally by their color, structure, and consistence. The B horizons show little clay accumulation, and that present is discernible only as thin clay skins on the soil aggregates. Since Edalgo silt loam and Muir silt loam show minor differences that are associated with differences in their parent materials, both soils are described as representative of the family. Mechanical analyses, pH, and organic-carbon determinations for Edalgo loam are given in table 11.

Profile description of Edalgo silt loam:

A_1 0 to 6 inches, dark grayish-brown (10YR 4/2, dry) to very dark brown (10YR 2.5/2, moist) silt loam or loam; soft when dry, very friable when moist; weak fine granular structure; medium acid; 2 to 8 inches thick; lower boundary clear and smooth.

B_1 6 to 16 inches, brown (7.5YR 4/2, dry) to dark-brown (7.5YR 3/2, moist) silty clay loam or clay loam; slightly hard when dry, friable when moist; strong fine and very fine subangular blocky

structure; medium to slightly acid; 8 to 15 inches thick; lower boundary gradual and smooth.

B_2 16 to 22 inches, brown (7.5YR 5/4, dry) to (7.5YR 4/4, moist) clay; extremely hard when dry, very firm when moist, and extremely plastic when wet; moderate fine and very fine subangular blocky structure; approximately neutral in reaction; contains a few small, hard, weathered ironstone chips and flakes of reddish-brown color; 5 to 12 inches thick; lower boundary gradual and smooth.

C_1 22 to 36 inches, light-gray (10YR 7/1, dry) to gray (10YR 6/1, moist) weathered shale of silty clay texture; very hard when dry, very firm when moist; massive to weakly laminated structure; neutral to slightly alkaline; contains brown mottles that are common and medium sized; layer 1 to 18 inches thick.

Dr 36 inches +, soft only partially weathered silty and clayey shales, conspicuously mottled with yellow, gray, and brown; neutral to mildly alkaline; many feet thick.

Profile description of Muir silt loam:

A_1 0 to 14 inches, grayish-brown (10YR 5/2, dry) to very dark grayish-brown (10YR 3/2, moist) silt loam; soft when dry, friable when moist; weak fine granular structure; slightly acid; 8 to 18 inches thick; lower boundary clear and smooth.

A_3-B_1 14 to 26 inches, dark grayish-brown (10YR 4/2.5, dry) to very dark brown (10YR 2/2, moist) silty clay loam; slightly hard when dry, friable when moist; moderate coarse granular structure; slightly to moderately acid; 6 to 16 inches thick; lower boundary gradual and smooth.

B_2 26 to 34 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) silty clay loam; hard when dry, friable when moist; moderate very fine subangular blocky structure; neutral to slightly acid; contains a few dark reddish-brown mottles; 6 to 14 inches thick; lower boundary gradual and smooth.

C_1 34 to 50 inches, yellowish-brown (10YR 5/4, dry) to dark yellowish-brown (10YR 4/4, moist) silty clay loam; slightly hard to hard when dry, friable when moist; massive; slightly acid to neutral; a few feet to many feet thick.

Lancaster family

In this family are soils of the Albion, Elmo, Geary, Lancaster, Langley, Marydel, Pratt, Salemsburg, Shellabarger, Windom, and Yordy series. The members of this family have profile characteristics modal for the Brunizem great soil group. They have well-developed textural B_2 horizons that contain somewhat finer textured materials than either the A_1 or C horizons. Clay-flow surfaces are clearly visible on the faces of the soil aggregates in the B_2 horizons. All horizons are better defined than in the soils of the Edalgo-Muir family. Analytical data for Lancaster loam, a typical soil in this family, are given in table 12. The profile characteristics described below are for another profile in the same soil. Depth, thickness, and development of the horizons therefore vary somewhat from those given for the profile in the table on analytical data.

Profile description of Lancaster loam:

A_1 0 to 5 inches, dark grayish-brown (10YR 4/1.5, dry) to very dark brown (10YR 2/2, moist) loam; soft when dry, very friable when moist; weakly developed fine and medium granular structure; medium acid; lower boundary clear and smooth.

B_1 5 to 14 inches, brown (7.5YR 4/2, dry) to dark-brown (7.5YR 3/2, moist) clay loam; hard when dry, friable when moist; moderate medium granular to very fine subangular blocky structure; medium acid; lower boundary clear and smooth.

B_{21} 14 to 22 inches, brown (7.5YR 4/4, dry) to reddish-brown (5YR 4/4, moist) heavy clay loam; very hard when dry, friable when moist; moderately coarse prismatic structure breaking to moderate medium subangular blocky structure; neutral to slightly acid; lower boundary gradual and smooth.

B_{22} 22 to 36 inches, yellowish-red (5YR 5/6, dry) to (5YR 4/6, moist) clay loam; very hard when dry, friable when moist; weak to moderate coarse prismatic structure breaking to weak to moderate coarse subangular blocky structure; approximately neutral in reaction; lower boundary gradual and smooth.

B_3 36 to 52 inches, yellowish-red (5YR 5/6, dry) to (5YR 4/6, moist) fine sandy clay loam; hard when dry, friable when moist; weakly developed coarse subangular blocky structure; approximately neutral in reaction; lower boundary gradual and smooth.

C 52 to 66 inches, yellowish-red (5YR 5.5/6, dry) to (5YR 4.5/6, moist) light sandy clay loam; massive; hard when dry, friable when moist; approximately neutral in reaction.

Westfall family

In this family are soils of the Longford, Tescott, and Westfall series. The soils have strongly developed textural B_2 horizons, which are distinctly finer textured than either the A_1 or C horizons. The aggregates in the B_2 horizon have strongly developed clay-flow surfaces. Differentiation between horizons is distinct, but the textural break between the A and B horizons is less abrupt than in the soils of the Bonaccord family. Mechanical analyses, pH, and organic-carbon content determinations for Westfall silt loam are given in table 11.

Profile description of Westfall silt loam:

A_1 0 to 6 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) silt loam; soft when dry, very friable when moist; weak to moderate fine crumb structure; slightly acid to moderately acid; lower boundary clear and smooth.

A-B 6 to 15 inches, brown (7.5YR 5/3, dry) to dark-brown (7.5YR 3.5/2, moist) clay loam; hard when dry, friable when moist; moderately developed very fine subangular blocky structure; slightly acid to medium acid; lower boundary clear and smooth.

B_{21} 15 to 22 inches, reddish-brown (5YR 4.5/4, dry) to (5YR 4/4, moist) silty clay; very hard when dry, very plastic when wet; weakly developed medium prismatic structure breaking to moderate medium angular and subangular blocky structure; slightly acid; lower boundary gradual and smooth.

B_{22} 22 to 30 inches, yellowish-red (5YR 5/5, dry) to reddish-brown (5YR 4/4, moist) heavy silty clay loam; very hard when dry, firm when moist, and plastic when wet; weak medium prismatic structure breaking to moderate medium subangular blocky structure; approximately neutral in reaction.

B_3 30 to 38 inches, yellowish-red (5YR 5/6, dry) to (5YR 4/6, moist) clay loam; hard when dry, friable when moist; massive; approximately neutral in reaction but horizon contains a few small nodules of calcium carbonate; lower boundary gradual and smooth.

C 38 to 48 inches, yellowish-red (5YR 5/6, dry) to (5YR 4/6, moist) clay loam; massive; hard when dry, friable when moist; neutral to slightly alkaline; contains a few fragments of sandstone and a few concretions of ironstone.

BONACCORD FAMILY

In this family are soils of the Bonaccord and Malmgren series. The soils have all the properties normal for Brunizem soils. In addition they have weakly expressed properties that are characteristic of the Planosol great soil group. Their B_2 horizons show strong textural development. The break between the A_1 and B_2 horizon is clear, or 1 to 2½ inches wide. But an incipient A_2 horizon is forming directly above the fine-textured B_2 horizon. Mechanical analyses, pH, and organic-carbon content determinations for Bonaccord silty clay loam are given in table 11.

Profile description of Bonaccord silty clay loam:

A_1 0 to 6 inches, gray (10YR 5/1, dry) to dark-gray (10YR 4/1, moist) silty clay loam; soft when dry, friable when moist, plastic when wet; weak fine granular structure; medium to slightly acid; 4 to 8 inches thick; lower boundary clear and smooth.

B_1-A_2 6 to 16 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist) silty clay; hard when dry, friable when moist, and extremely plastic when wet; moderate medium granular structure; neutral to slightly acid; surfaces of aggregates are coated with light gray; coating is very easily seen when the soil is dry; 6 to 14 inches thick; lower boundary clear and smooth.

B_2 16 to 24 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) silty clay; very hard when dry, firm when moist, and plastic when wet; weak medium subangular blocky structure; neutral to slightly acid; aggregates have moderate clay flow surfaces; 6 to 15 inches thick; lower boundary gradual and smooth.

B_3 24 to 36 inches, brown (10YR 5/3, dry) to grayish-brown (10YR 4/2, moist) heavy silty clay loam; very hard when dry, firm when moist, and plastic when wet; weak medium fine and very fine subangular blocky structure; neutral to slightly acid; contains moderate numbers of distinct yellowish-red mottles; 6 to 18 inches thick; lower boundary gradual and smooth.

C_1 36 to 48 inches, light yellowish-brown (10YR 6/4, dry) to brown (10YR 5/3, moist) silty clay loam; strongly mottled with yellowish-red and yellow; hard when dry, firm when moist, and plastic when wet; massive; neutral to mildly alkaline; few to many feet thick.

PLANOSOLS

In the Planosol great soil group are dark-colored grassland soils with an A_1, A_2, B_2, B_3, and C sequence in their horizons. They are developing in small basinlike depressions on the uplands and terraces. Surface drainage is ponded and internal drainage very slow. The soils have dark-colored A_1 horizons. Their A_2 horizons—thin, platy, and light colored—rest abruptly on fine-textured, compact, slowly permeable B_2 horizons.

The soils in this great soil group are readily distinguished from Chernozem and Brunizem soils by their distinct A_2 horizons, the abrupt boundaries between the A_2 and B_2 horizons, and the accumulation of a clay in their B_2 horizons. Seasonal water tables often develop over the compact layer, but at other times the soils are droughty.

Profile description of Lindsborg silt loam:

A_1 0 to 10 inches, gray (10YR 5/1, dry) to very dark gray (10YR 3/1, moist) silt loam; soft when dry, very friable when moist; moderate coarse, medium and fine granular structure; medium acid; 6 to 12 inches thick; lower boundary abrupt and smooth.

A_2 10 to 12 inches, light-gray (10YR 6.5/1, dry) to dark-gray (10YR 4.5/1, moist) silt loam; soft when dry, very friable when moist; moderate thin platy structure; horizon appears very vesicular; medium acid; 1 to 6 inches thick; lower boundary abrupt and smooth.

B_2 12 to 28 inches, gray (10YR 5/1, dry) to very dark gray (10YR 3/1, moist) clay; extremely hard when dry, extremely plastic when wet; strong medium prismatic structure breaking to moderate medium angular blocky; contains a few small shotlike concretions, presumably of iron and manganese; slightly acid; lighter colored material from the horizon above frequently works down into cracks and coats surfaces of aggregates; 14 to 24 inches thick; lower boundary gradual and smooth.

C_1 28 to 46 inches, gray (10YR 5.5/1, dry) to dark-gray (10YR 4/1, moist) silty clay; extremely hard when dry, extremely plastic when wet; massive to very weakly developed fine blocky structure; contains a few small shotlike concretions of iron and manganese in the upper part; mildly alkaline but not calcareous; horizon becomes gradually lighter in color with increasing depth; few to many feet thick.

LITHOSOLS

The soils of this great soil group are shallow and only weakly developed. The entire thickness of soil and parent material rarely exceeds 20 inches. The sequence of horizons generally is A_1, A-C, and Dr, but it is often difficult to tell where one ends and the next begins. The soils vary in color, texture, and reaction, depending upon the bedrock. Lithosols are youthful, and they often occur where erosion has exceeded the rate of weathering and soil development. Only one family, the Hedville, is recognized in the county.

Profile description of Hedville loam:

A_1 0 to 6 inches, brown (7.5YR 4/2, dry) to dark-brown (7.5YR 3/2, moist) loam containing many flat chips of sandstone; very friable when moist; soft when dry; weak fine granular structure; medium acid; 3 to 10 inches thick; lower boundary clear and smooth.

C_1 6 to 15 inches, brown (7.5YR 5/3, dry) to (7.5YR 4/3, moist) disintegrated sandstone and sandy shale containing an abundance of ironstone and sandstone fragments; strongly mottled with brownish yellow (10YR 6/6, dry); medium acid; 8 to 12 inches thick.

Dr 15 inches +, light olive-gray (dry) only partially disintegrated or unweathered fine-textured shale containing much fine-textured sandstone; moderately mottled with pale-olive and reddish-brown stains; induration of horizon varies from soft clay shales to beds of sandy clay shale.

REGOSOLS

The soils of this group have profile characteristics that are very similar to those described for Lithosols. They differ in having thick, friable, unconsolidated parent materials. The sequence of horizons is A_1, A-C, and C, but boundaries are difficult to distinguish and all the horizons except the weakly developed A_1 may be absent.

This group is made up of one soil type, or two mapping units of limited distribution. The soils occur on coarse cobbly and channery outwash materials on ridges. Erosion usually exceeds weathering in these youthful soils.

Profile description of Hallville loam:

A_1 0 to 4 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist) loam; soft when dry, very friable when moist; weak medium granular structure; medium acid; 1 to 6 inches thick; lower boundary clear and smooth.

A-C 4 to 12 inches, brown (7.5YR 4/2, dry) to dark-brown (7.5YR 3/2, moist) silt loam containing a few ironstone pebbles; slightly hard when dry, friable when moist; weak very fine subangular blocky structure; medium acid; 2 to 14 inches thick; lower boundary gradual and smooth.

C 12 to 48 inches +, brown (7.5YR 4.5/3, dry) to dark-brown (7.5YR 3.5/3, moist) loose fine gravel in a sparse matrix of silty clay loam; somewhat more yellowish in color with increase in depth; slightly acid; few to many feet thick.

ALLUVIAL SOILS

These are youthful soils little changed by their environment. They are developing in recently deposited alluvial materials on the flood plains and low terraces. Modal profiles have an A_1, A-C, and C horizon sequence, but in places only weakly developed A_1 horizons can be determined. Many of these soils show varying degrees of stratification. Such stratification occurred when they were deposited and does not represent the development of soil horizons through the action of soil-forming factors. Three families, differing in drainage characteristics and amount of oxidation, are recognized in the county.

HUMBARGER FAMILY

The members of this family are well-drained, well-aerated alluvial soils developing in coarse- to fine-textured parent materials.

Profile description of Humbarger silt loam:

A_1 0 to 8 inches, grayish-brown (10YR 5/1.5, dry) to dark-gray (10YR 4/1, moist) silt loam; soft when dry, very friable when moist; weak fine granular structure; calcareous; 4 to 10 inches thick; lower boundary clear and smooth.

C_1 8 to 16 inches, light brownish-gray (10YR 6/2, dry) to dark grayish-brown (10YR 4/2, moist) light silty clay loam; soft when dry, very friable when moist; weak medium subangular blocky structure; calcareous; 3 to 15 inches thick; lower boundary gradual and smooth.

C_2 16 to 22 inches, light brownish-gray (10YR 6/2, dry) to grayish-brown (10YR 5/2, moist) silt loam; slightly hard when dry, friable when moist; massive; calcareous; 3 to 18 inches thick; lower boundary gradual and smooth.

C_3 22 to 60 inches, very pale brown (10YR 7/3, dry) to pale-brown (10YR 6/3, moist) silt loam or light silty clay loam; slightly hard when dry, friable when moist; strongly calcareous; massive; usually contains thin strata of coarser and finer textured materials; finely disseminated lime flour occurs throughout the soil profile.

FORE FAMILY

The soils of this family are poorly drained and show signs of poor aeration. They are developing in fine-textured parent materials on the nearly level and depressional areas of the flood plains and low terraces.

Profile description of Fore clay:

A_1 0 to 5 inches, gray (10YR 5/1, dry) to dark-gray (10YR 4/1, moist) clay; strongly calcareous; hard when dry, plastic when wet; moderate very fine granular structure; 3 to 6 inches thick; lower boundary clear and smooth.

A-C 5 to 13 inches, gray (10YR 5/1, dry) to dark-gray (10YR 4/1, moist) clay; extremely hard when dry, extremely plastic when wet; moderate fine blocky structure; moderately calcareous; 5 to 10 inches thick; lower boundary gradual and smooth.

C_1 13 to 22 inches, gray (10YR 6/1, dry) to dark-gray (10YR 4/1, moist) clay; extremely hard when dry, extremely plastic when wet; strongly calcareous; massive to very weakly developed very coarse subangular blocky structure; 8 to 14 inches thick; lower boundary gradual and smooth.

C_2 22 to 48 inches, grayish-brown (2.5Y 5/2, dry) to dark grayish-brown (2.5Y 4/2, moist) clay; extremely hard when dry, extremely plastic when wet; massive; strongly calcareous; a few inches to several feet thick.

SUTPHEN FAMILY

The soils of this family possess characteristics gradational between wet alluvial soils and Grumosols. They are developing in poorly drained, fine-textured alluvial materials. Their lower subsoils are dull gray; strong graying is normally absent. Soil horizons are not distinct. Soils of this family possess properties of weak self-swallowing Grumosols, but the process has not been dominant in their development. Surface horizons may or may not be leached free of lime, and the subsurface profile may or may not have weak horizons of lime accumulation.

Profile description of Sutphen silty clay:

A_{11} 0 to 3 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist) silty clay; very hard when dry, very plastic when wet; moderate medium and fine granular structure; approximately neutral in reaction; 2 to 6 inches thick; lower boundary clear and smooth.

A_{12} 3 to 16 inches, very dark gray (10YR 2.5/1, dry) to black (10YR 2/1, moist) clay; very hard when dry, extremely plastic when wet; moderate and medium coarse granular structure; neutral in reaction; 10 to 12 inches thick; lower boundary gradual and smooth.

AC_g 16 to 26 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist) clay; very hard when dry, extremely plastic when wet; weak coarse and medium blocky structure; neutral to mildly alkaline; 6 to 15 inches thick; lower boundary gradual and smooth.

C_{gca} 26 to 32 inches, grayish-brown (2.5Y 5/2, dry) to dark grayish-brown (2.5Y 3.5/2, moist) clay; extremely hard when dry, extremely plastic when wet; massive to very weakly developed very coarse angular blocky structure; calcareous; contains a few hard calcium carbonate concretions; material from upper horizons works into cracks in this horizon and appears as somewhat darker colored streaks and bands with nearly vertical orientation; 4 to 8 inches thick; lower boundary gradual and smooth.

C_g 32 to 40 inches, pale-brown (10YR 6/2.5, dry) to brown (10YR 5/3, moist) clay; very hard when dry, very plastic when wet; massive; calcareous; 6 to 12 inches thick; lower boundary gradual and smooth.

D 40 to 60 inches, light yellowish-brown (10YR 6/4, dry) to brown (10YR 5/3, moist) silty clay loam; hard when dry, firm when moist; massive; calcareous; several feet thick.

SOIL SURVEY METHODS AND DEFINITIONS

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

Field study.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern, but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart and sometimes they are much closer. In most soils each boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. The texture is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture. For example, a claypan 18 inches below the surface may limit the growth of roots to a shallow surface layer and make the plants more susceptible to damage during prolonged periods of drought. Structure is defined in terms of distinctness, size, and shape of the soil aggregates. For example, "moderate medium subangular blocky" means moderately distinct, medium-sized aggregates of subangular blocky shape.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; and acidity or alkalinity of the soil as measured by chemical tests.

Classification.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage, are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture, but are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Miscellaneous land types.—Areas that have little true soil are not classified by types and series. Instead, they are identified by descriptive names, such as Alluvial land (Ad), Made land, and Rough broken and rough stony land, Vernon and Hedville soil materials (Re).

Soil complex.—Where two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. The Bonaccord silty clay loam-Solonetz complex is a soil complex mapped in this county.

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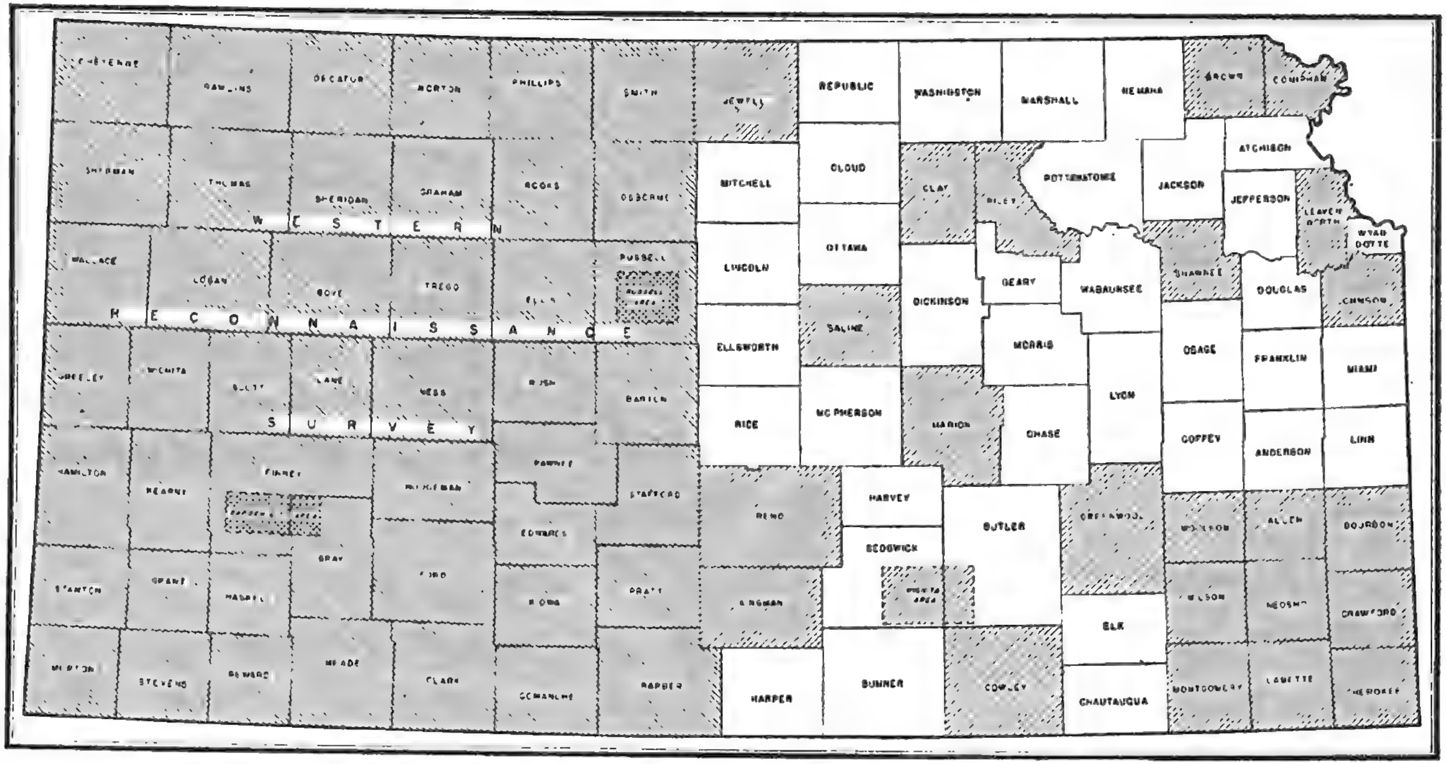

Areas surveyed in Kansas shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; cross-hatching indicates areas covered by both types of surveys.

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(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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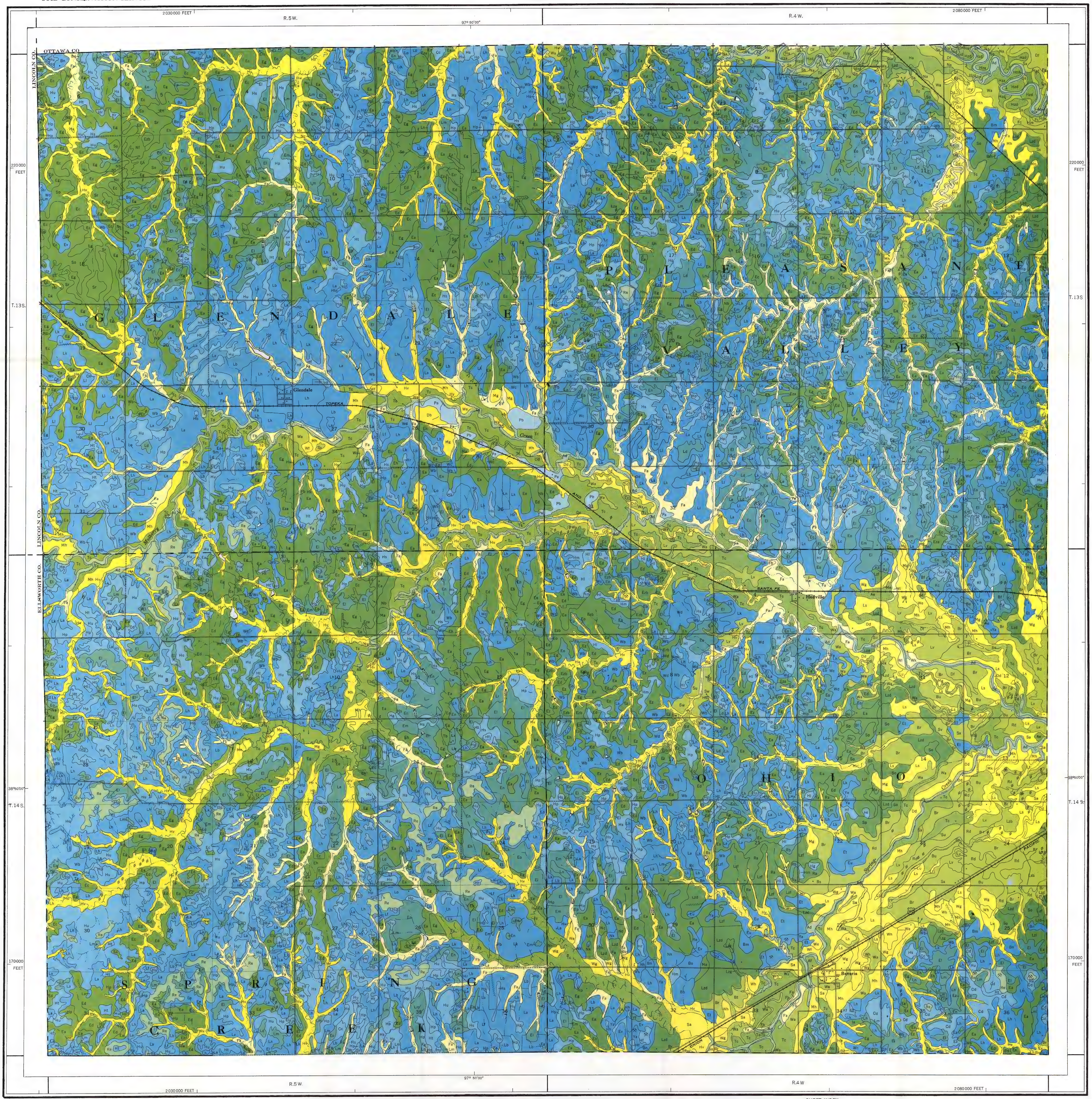
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
SALINE COUNTY - KANSAS
SHEET NO. 1

KANSAS AGRICULTURAL EXPERIMENT STATION



Soils surveyed 1946-49 by A. J. Cline, in Charge, James T. Neill, and Orville W. Saffry, Soil Conservation Service, and Paul L. Brown and Darold A. Dodge, Kansas Agricultural Experiment Station. Inspection and Correlation by William M. Johnson, Soil Conservation Service.

Scale 1:31,680

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

SHEET INDEX

1	2	3	
4	5	6	

Alphabetical Legend on Sheet No. 3
Color Grouping and Conventional Signs on Sheet No. 6

Map constructed by Cartographic Division, Soil Conservation Service, USDA, from 1938 aerial photographs.
Soils surveyed on 1938 aerial photographs.
Polyconic projection, 1927 North American datum.
10000-foot grid based on Kansas (North) rectangular coordinate system.

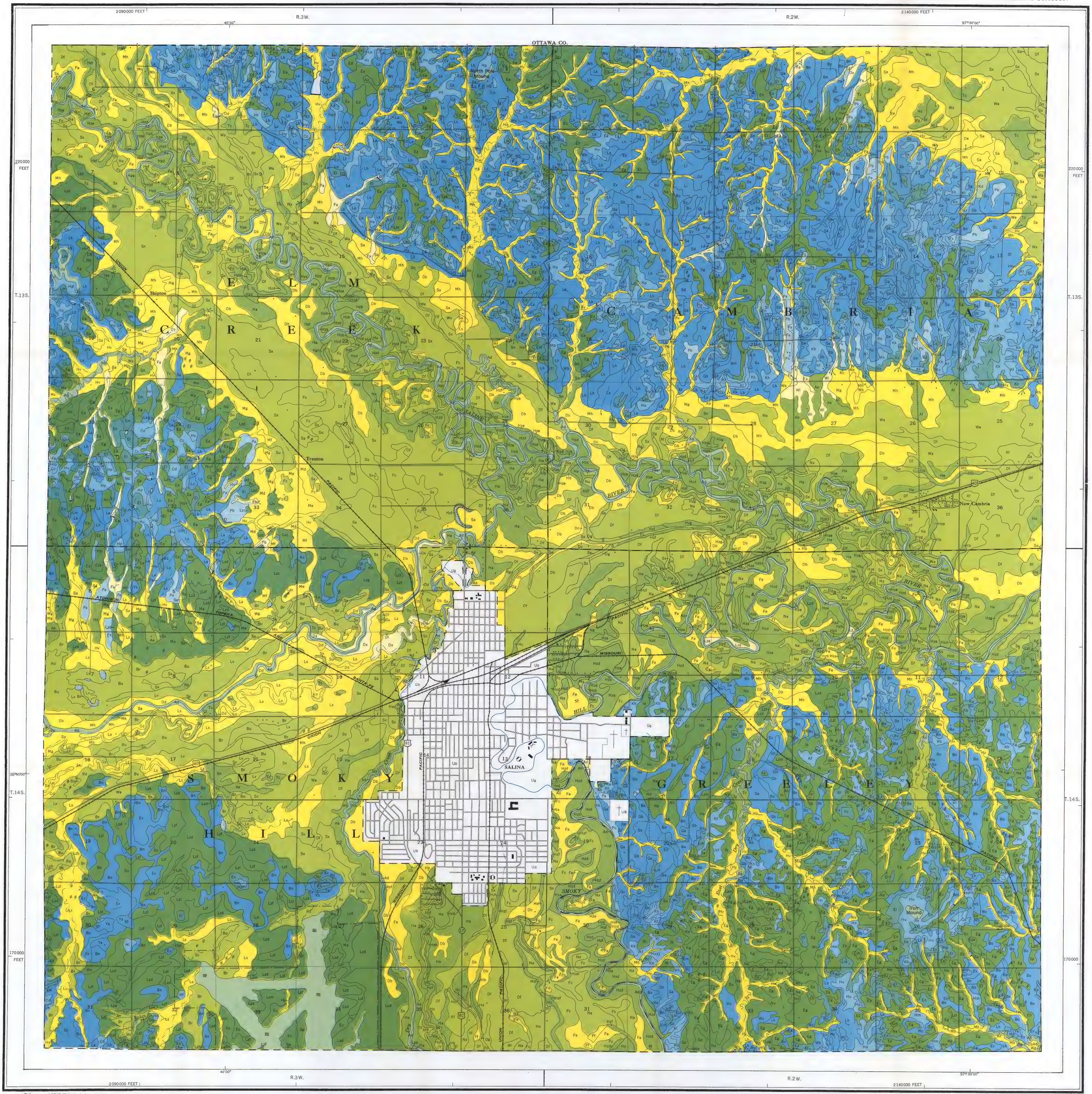
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

SALINE COUNTY - KANSAS

SHEET NO. 2

KANSAS AGRICULTURAL EXPERIMENT STATION



Soils surveyed 1946-49 by A. J. Cline, in Charge, James T. Neill, and Orville W. Saffry, Soil Conservation Service, and Paul L. Brown and Darold A. Dodge, Kansas Agricultural Experiment Station. Inspection and Correlation by William M. Johnson, Soil Conservation Service.

Scale 1:31,680

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

SHEET INDEX

1	2	3
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Soils surveyed on 1938 aerial photographs.
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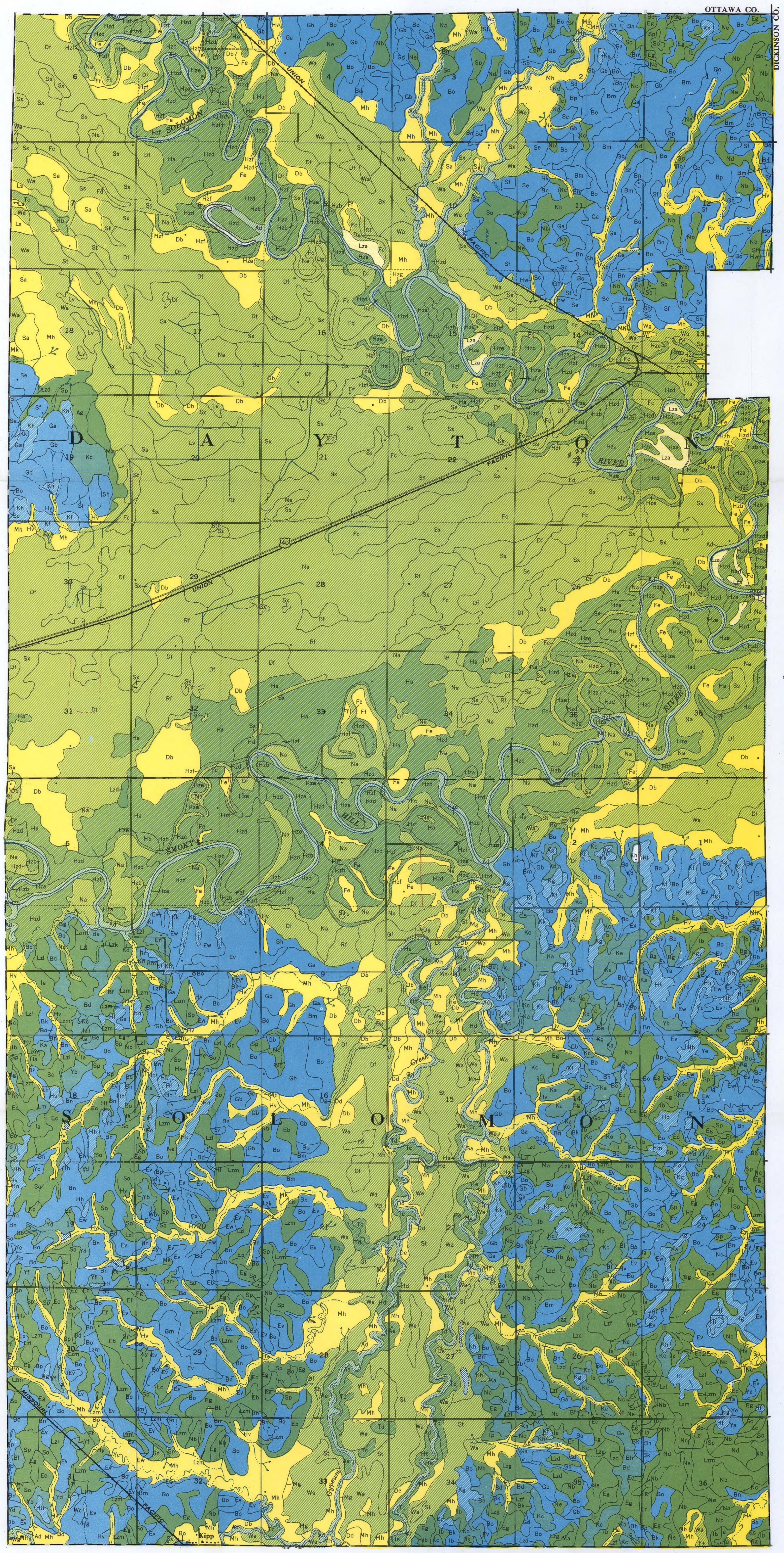
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

SALINE COUNTY - KANSAS

SHEET NO. 3

KANSAS AGRICULTURAL EXPERIMENT STATION



LEGEND

- Aa — Albion coarse sandy loam, shallow phase, 2-6 percent slopes
- Ab — Albion loam, 2-6 percent slopes
- Ac — Albion loam, 6-12 percent slopes
- Ad — Alluvial land
- Ae — Arkansas fine sandy loam, 0-2 percent slopes
- Af — Arkansas fine sandy loam, 2-6 percent slopes
- Ag — Assaria silt loam, 2-6 percent slopes
- Ah — Assaria silty clay loam, 2-6 percent slopes, eroded
- Bd — Benfield silty clay loam, shallow phase, 2-6 percent slopes
- Be — Benfield silty clay loam, shallow phase, 2-6 percent slopes, eroded
- Bf — Benfield silty clay loam, shallow phase, 2-6 percent slopes, severely eroded
- Bg — Benfield silty loam, shallow phase, 6-12 percent slopes, severely eroded
- Bh — Benfield silty clay loam, 2-6 percent slopes
- Bb and Bk — Benfield silty clay loam, 2-6 percent slopes, eroded
- Bc and Bl — Benfield silty clay loam, 2-6 percent slopes, severely eroded
- Bm — Berg silt loam, 0-2 percent slopes
- Bn — Berg silt loam, 2-6 percent slopes
- Bo — Berg silty clay loam, 2-6 percent slopes, eroded
- Bp — Berg silty clay loam, 2-6 percent slopes, severely eroded
- Br — Bonaccord silty clay loam, 0-2 percent slopes
- Bs — Bonaccord silty clay loam, 2-6 percent slopes
- Bt — Bonaccord silty clay loam, 2-6 percent slopes, eroded
- Bu — Bonaccord silty clay loam Solonetz complex, 0-2 percent slopes
- Ca — Carlson silty clay loam, 2-6 percent slopes
- Cb — Carlson silty clay loam, 6-12 percent slopes
- Cc — Cloud silty clay loam, 2-6 percent slopes
- Cd — Cloud silty clay loam, 6-12 percent slopes
- Ce — Cloud silty clay loam, 6-12 percent slopes, severely eroded
- Da — Detroit loamy very fine sand, overwash phase, 0-2 percent slopes
- Db — Detroit silt loam, 0-2 percent slopes
- Dc — Detroit silt loam, 2-6 percent slopes
- Dd — Detroit silt loam, overwash phase, 0-2 percent slopes
- De — Detroit silt loam, overwash phase, 2-6 percent slopes
- Df — Detroit silty clay loam, 0-2 percent slopes
- Dg — Detroit silty clay loam, 2-6 percent slopes
- Dh — Detroit silty clay loam, 2-6 percent slopes, eroded
- Ea — Ebenezer loam, 2-6 percent slopes
- Eb — Ebenezer silt loam, 0-2 percent slopes
- Ec — Ebenezer silt loam, 2-6 percent slopes
- Ed — Ebenezer silt loam, colluvial phase, 2-6 percent slopes
- Ee — Ebenezer silt loam, colluvial phase, 2-6 percent slopes, eroded
- Ef — Ebenezer silty clay loam, 0-2 percent slopes, eroded
- Eg — Ebenezer silty clay loam, 2-6 percent slopes, eroded
- Eh — Ebenezer silty clay loam, 2-6 percent slopes, severely eroded
- Ek — Ebenezer silty clay loam, 6-12 percent slopes, eroded
- El — Edalgo silt loam, 2-6 percent slopes
- Em — Edalgo silt loam, 2-6 percent slopes, eroded
- En — Edalgo silt loam, 6-12 percent slopes
- Eo — Edalgo silt loam, 2-6 percent slopes, severely eroded
- Ep — Edalgo silt loam, 6-12 percent slopes, severely eroded
- Er — Elmo loam, terrace phase, 2-6 percent slopes
- Es — Elmo loam, terrace phase, 2-6 percent slopes, eroded
- Et — Elmo silt loam, terrace phase, 0-4 percent slopes
- Eu — Elmo silt loam, terrace phase, 0-4 percent slopes, eroded
- Ev — Elmo silt loam, 2-6 percent slopes
- Ew — Elmo silt loam, 6-12 percent slopes
- Ex — Elmo silty clay loam, 2-6 percent slopes, severely eroded
- Ey — Elmo silty clay loam, 6-12 percent slopes, severely eroded
- Ez — Englund silt loam, 2-6 percent slopes
- Eza — Englund silt loam, 2-6 percent slopes, eroded
- Ezb — Englund silt loam, 2-6 percent slopes, severely eroded
- Ezc — Englund silty clay loam, very shallow variant, 2-6 percent slopes
- Fa — Falun fine sandy loam, 0-2 percent slopes
- Fb — Falun fine sandy loam, 2-6 percent slopes
- Fc — Fore clay, 0-2 percent slopes
- Fd — Fore clay, 2-6 percent slopes
- Fe — Fore silty clay loam, deep over silt, 0-2 percent slopes
- Ff — Fore silty clay loam, deep over silt, 2-6 percent slopes
- Ga — Geary silt loam, 2-6 percent slopes
- Gb — Geary silt loam, 2-6 percent slopes, eroded
- Gc — Geary silt loam, 6-12 percent slopes
- Gd — Geary silt loam, 6-12 percent slopes, severely eroded
- Ha — Hall silt loam, 0-2 percent slopes
- Hb — Hall silt loam, 2-6 percent slopes
- Hc — Hall silt loam, 2-6 percent slopes, eroded
- Hd — Hall silt loam, brown subsoil variant, 0-2 percent slopes
- He — Hall silt loam, brown subsoil variant, 2-6 percent slopes
- Hf — Hallville loam, 2-6 percent slopes
- Hg — Hallville loam, 2-6 percent slopes, eroded
- Hh — Hallville loam, 6-12 percent slopes
- Hk — Hallville loam, 6-12 percent slopes, severely eroded
- Hl — Hallville loam, shallow phase, 2-6 percent slopes
- Hm — Hallville loam, shallow phase, 2-6 percent slopes, severely eroded
- Hn — Hallville loam, shallow phase, 6-12 percent slopes
- Ho — Hallville loam, shallow phase, 6-12 percent slopes, severely eroded
- Hp — Hedville loam, 2-6 percent slopes
- Hr — Hedville loam, 2-6 percent slopes, eroded
- Hs — Hedville loam, 6-12 percent slopes
- Ht — Hedville stony loam, 2-6 percent slopes
- Hu — Hedville stony loam, 6-12 percent slopes
- Hv — Hobbs silt loam, 0-2 percent slopes
- Hw — Hobbs silt loam, 0-2 percent slopes, eroded
- Hx — Hobbs silt loam, 2-6 percent slopes
- Hy — Hobbs silt loam, 2-6 percent slopes, eroded
- Hz — Hobbs silt loam, light-colored variant, 0-2 percent slopes
- Hza — Humbarger loam, 0-2 percent slopes
- Hzb — Humbarger loam, 2-6 percent slopes
- Hzc — Humbarger loam, 2-6 percent slopes, eroded
- Hzd — Humbarger silt loam, 0-2 percent slopes
- Hze — Humbarger silt loam, 2-6 percent slopes
- Hzf — Humbarger silt loam, 2-6 percent slopes, eroded
- Hzg — Humbarger silt loam, 2-6 percent slopes, severely eroded
- Ia — Idana silt loam, 2-6 percent slopes
- Ib — Idana silt loam, 2-6 percent slopes, eroded
- Ic — Idana silty clay loam, 2-6 percent slopes, severely eroded
- Id — Idana silty clay loam, 6-12 percent slopes, eroded
- Ka — Kipp silt loam, 2-6 percent slopes
- Kb — Kipp silt loam, 6-12 percent slopes
- Kc — Kipp silty clay loam, 2-6 percent slopes, eroded
- Kd — Kipp silty clay loam, 2-6 percent slopes, severely eroded
- Ke — Kipp silty clay loam, 6-12 percent slopes, severely eroded
- Kf — Kipson shaly silt loam, 2-6 percent slopes, eroded
- Kg — Kipson shaly silt loam, 6-12 percent slopes, severely eroded
- Kh — Kipson silt loam, 2-6 percent slopes
- Kk — Kipson silt loam, 6-12 percent slopes
- Kl — Kipson silt loam, over 12 percent slopes
- La — Lancaster fine sandy loam, 2-6 percent slopes
- Lb — Lancaster fine sandy loam, 2-6 percent slopes, eroded
- Lc — Lancaster fine sandy loam, 2-6 percent slopes, severely eroded
- Ld — Lancaster fine sandy loam, shallow phase, 2-6 percent slopes
- Le — Lancaster fine sandy loam, shallow ph se, 2-6 percent slopes, eroded
- Lf — Lancaster fine sandy loam, 6-12 percent slopes
- Lg — Lancaster fine sandy loam, shallow phase, 6-12 percent slopes
- Lh — Lancaster loam, 2-6 percent slopes
- Lk — Lancaster loam, 2-6 percent slopes, eroded
- Ll — Lancaster loam, 2-6 percent slopes, severely eroded
- Lm — Lancaster loam, shallow phase, 2-6 percent slopes
- Ln — Lancaster loam, shallow phase, 2-6 percent slopes, eroded
- Lo — Lancaster loam, 6-12 percent slopes
- Lp — Lancaster loam, 6-12 percent slopes, severely eroded
- Lr — Lancaster loam, shallow phase, 6-12 percent slopes
- Ls — Langley silt loam, 0-2 percent slopes
- Lt — Langley silt loam, 2-6 percent slopes
- Lu — Langley silty clay loam, 2-6 percent slopes, eroded
- Lv — Langley silt loam-Solonetz complex, 0-2 percent slopes
- Lw — Lanham silt loam, 2-6 percent slopes
- Lx — Lanham silt loam, 2-6 percent slopes, severely eroded
- Ly — Lanham silt loam, 6-12 percent slopes
- Lz — Lincoln loamy fine sand, 0-2 percent slopes
- Lza — Lincoln loamy fine sand, 2-6 percent slopes
- Lzb — Lindsborg silt loam, 0-2 percent slopes
- Lzc — Lockhard loamy fine sand, overblown phase, 2-6 percent slopes
- Lzd — Lockhard silt loam, 0-2 percent slopes
- Lze — Lockhard silt loam, 0-2 percent slopes, eroded
- Lzf — Lockhard silt loam, 2-6 percent slopes
- Lzg — Lockhard silt loam, 2-6 percent slopes, eroded
- Lzh — Lockhard silt loam, 2-6 percent slopes severely eroded
- Lzk — Longford silt loam, 0-2 percent slopes
- Lzl — Longford silt loam, 2-6 percent slopes
- Lzm — Longford silty clay loam, 2-6 percent slopes, eroded
- Made land, 0-2 percent slopes
- Ma — McPherson silt loam, 0-3 percent slopes
- Mb — Malmgren silt loam, 0-2 percent slopes
- Mc — Malmgren silt loam, 2-6 percent slopes
- Md — Marydel fine sandy loam, 0-2 percent slopes
- Me — Marydel loam, poorly drained variant, 0-2 percent slopes
- Mf — Marydel loamy fine sand, 0-2 percent slopes
- Mg — Marydel silt loam, 0-2 percent slopes
- Mh — Muir silt loam, 0-2 percent slopes
- Mk — Muir silt loam, 2-6 percent slopes
- Na — New Cambria silty clay loam, 0-2 percent slopes
- Nb — Niles silt loam, 0-2 percent slopes
- Nc — Niles silt loam, 2-6 percent slopes
- Nd — Niles silty clay loam, 0-2 percent slopes, eroded
- Ne — Niles silty clay loam, 2-6 percent slopes, eroded
- Nf — Niles silty clay loam, 2-6 percent slopes, severely eroded
- Ng — Niles silt loam, 2-6 percent slopes, severely eroded
- Nh — Ninnescah silt loam, 0-2 percent slopes
- Nk — Ninnescah silt loam, 2-6 percent slopes
- Pa — Pratt fine sandy loam, 2-6 percent slopes
- Pb — Pratt fine sandy loam, 2-6 percent slopes, eroded
- Ra — Rentide silt loam, 2-6 percent slopes
- Rb — Rentide silt loam, moderately shallow phase, 2-6 percent slopes
- Rc — Rentide silty clay loam, 2-6 percent slopes, eroded
- Rd — Rokeby silt loam, 0-2 percent slopes
- Re — Rough broken and Rough stony land, Vernon and Hedville soils materials
- Rf — Roxbury silty clay loam, 0-2 percent slopes
- Rg — Roxbury silty clay loam, 2-6 percent slopes, eroded
- Sa — Salemsburg silt loam, 0-2 percent slopes
- Sb — Shellabarger fine sandy loam, 2-6 percent slopes
- Sc — Shellabarger fine sandy loam, 2-6 percent slopes, eroded
- Sd — Shellabarger fine sandy loam, 2-6 percent slopes, severely eroded
- Se — Shellabarger loam, 2-6 percent slopes
- Sf — Shellabarger loam, 2-6 percent slopes, eroded
- Sg — Shellabarger loam, 2-6 percent slopes, severely eroded
- Sh — Shellabarger loam, 6-12 percent slopes, eroded
- Sk — Shellabarger silt loam, 0-2 percent slopes
- Sl — Shellabarger silt loam, 2-6 percent slopes
- Sm — Shellabarger silt loam, 2-6 percent slopes, eroded
- Sn — Smoky Butte silt loam, 0-2 percent slopes
- So — Smolan silt loam, 2-6 percent slopes
- Sp — Smolan silt loam, 2-6 percent slopes, eroded
- Sr — Smolan silt loam, 2-6 percent slopes, severely eroded
- Ss — Solomon clay, 0-2 percent slopes
- St — Solomon clay, low lime variant, 0-2 percent slopes
- Su — Stimmel silt loam, 0-2 percent slopes
- Sv — Stimmel silt loam, 2-6 percent slopes
- Sw — Stimmel silty clay loam, 2-6 percent slopes, severely eroded
- Sx — Sutphen silty clay, 0-2 percent slopes
- Ta — Tescott silt loam, 2-6 percent slopes
- Tb — Tescott silty clay loam, 2-6 percent slopes, eroded
- Tc — Tobin silt loam, 0-2 percent slopes
- Td — Tobin silt loam, 2-6 percent slopes
- Va — Vernon silty clay loam, 2-6 percent slopes
- Vb — Vernon silty clay loam, 2-6 percent slopes, severely eroded
- Vc — Vernon silty clay loam, 6-12 percent slopes
- Wa — Wabash silty clay loam, 0-2 percent slopes
- Wb — Westfall silt loam, 2-6 percent slopes
- Wc — Westfall silty clay loam, 2-6 percent slopes, eroded
- Wd — Westfall silty clay loam, 2-6 percent slopes, severely eroded
- We — Windom fine sandy loam, 0-2 percent slopes
- Wf — Windom fine sandy loam, 2-6 percent slopes
- Wg — Windom loam, 0-2 percent slopes
- Wh — Windom loam, 2-6 percent slopes
- Wk — Windom loamy fine sand, sandy substratum variant, 0-2 percent slopes
- Wl — Windom loamy fine sand, sandy substratum variant, 2-6 percent slopes
- Ya — Yordy loam, 2-6 percent slopes
- Yb — Yordy loam, shallow phase, 2-6 percent slopes
- Yc — Yordy loam, 6-12 percent slopes
- Yd — Yordy loam, shallow phase, 6-12 percent slopes
- Ye — Yordy silty clay loam, 2-6 percent slopes, eroded
- Yf — Yordy silty clay loam, shallow phase, 2-6 percent slopes, eroded
- Ua — Urban land, soils unclassified

Soils surveyed 1946-49 by A. J. Cline, in Charge, James T. Neill, and Orville W. Saffry, Soil Conservation Service, and Paul L. Brown and Darold A. Dodge, Kansas Agricultural Experiment Station. Inspection and Correlation by William M. Johnson, Soil Conservation Service.

Scale 1:31,680

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

SHEET INDEX

1 2 3
4 5 6

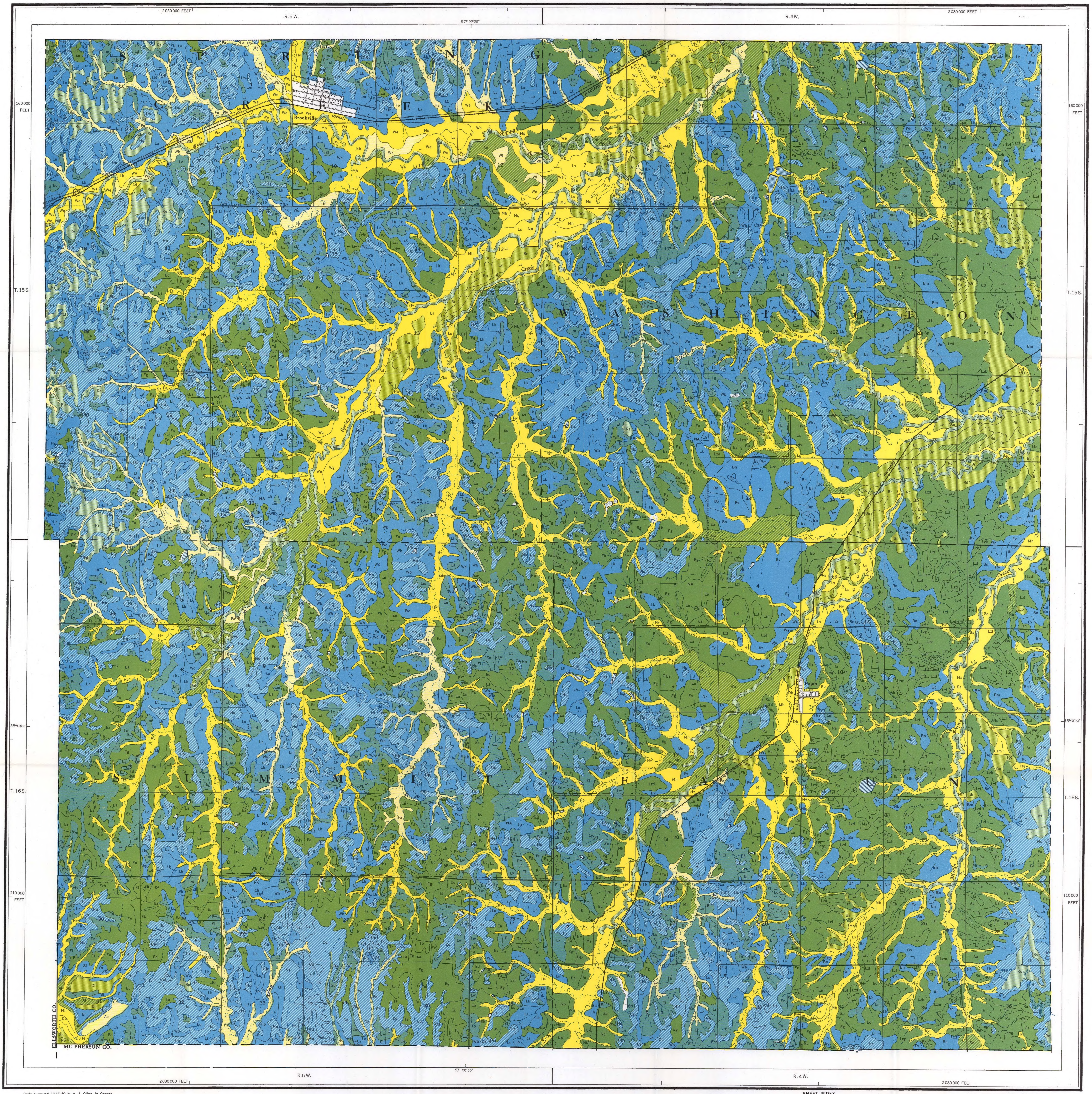
Color Grouping and Conventional Signs on Sheet No. 6

Map constructed by Cartographic Division, Soil Conservation Service, USDA, from 1938 aerial photographs. Soils surveyed on 1938 aerial photographs. Polyconic projection, 1927 North American datum. 10000-foot grid based on Kansas (North) rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
SALINE COUNTY - KANSAS
SHEET NO. 4

KANSAS AGRICULTURAL EXPERIMENT STATION



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Scale 1:31,680

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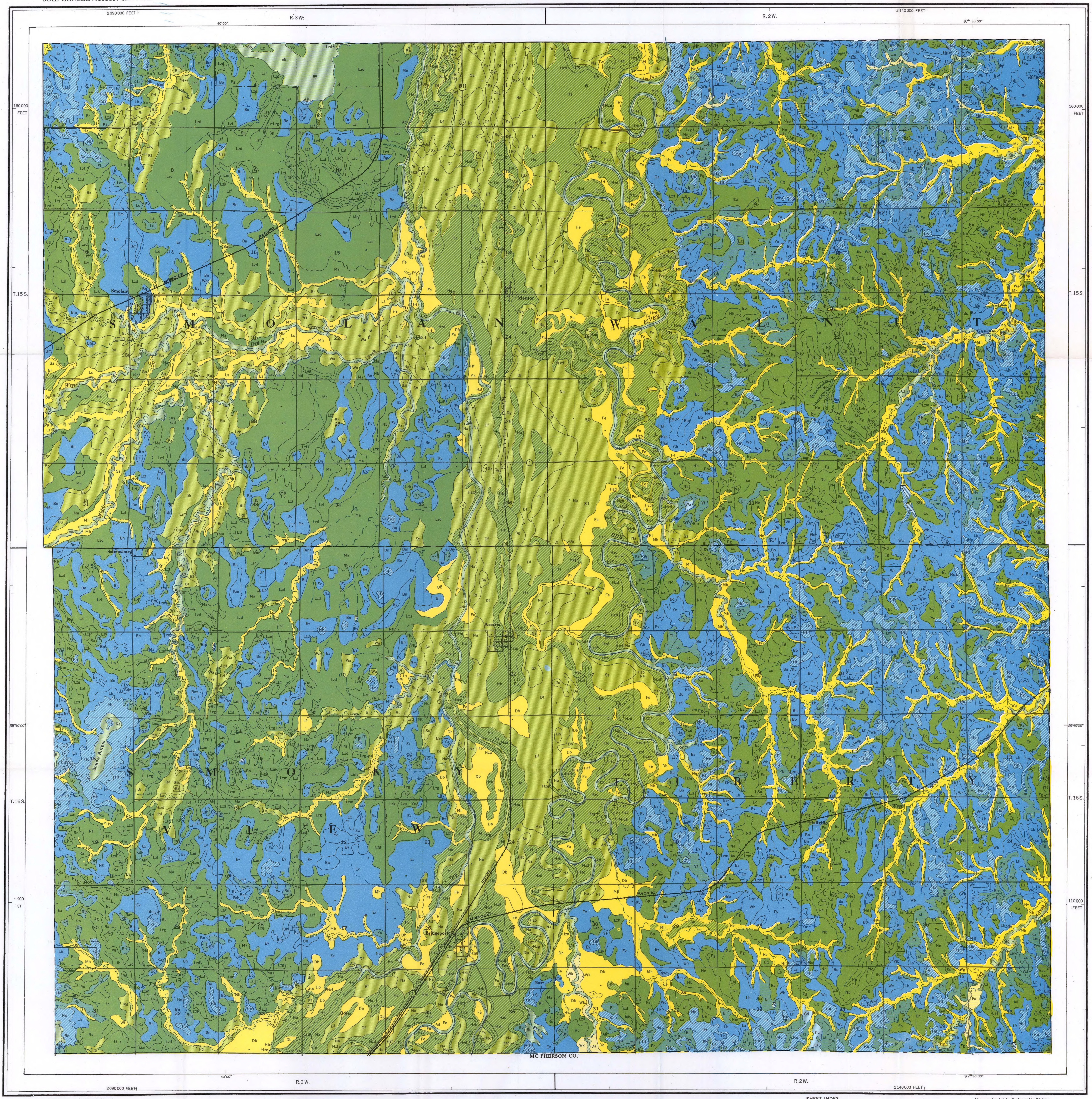
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

SALINE COUNTY - KANSAS

SHEET NO. 5

KANSAS AGRICULTURAL EXPERIMENT STATION



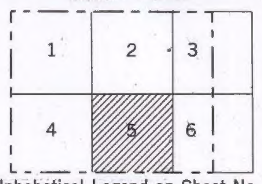
Soils surveyed 1946-49 by A. J. Cline, in Charge, James T. Neill, and Orville W. Saffry, Soil Conservation Service, and Paul L. Brown and Darold A. Dodge, Kansas Agricultural Experiment Station. Inspection and Correlation by William M. Johnson, Soil Conservation Service.

Scale 1:31,680

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

SHEET INDEX



Alphabetical Legend on Sheet No. 3
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Soils surveyed on 1938 aerial photographs.
Polyconic projection, 1927 North American datum.
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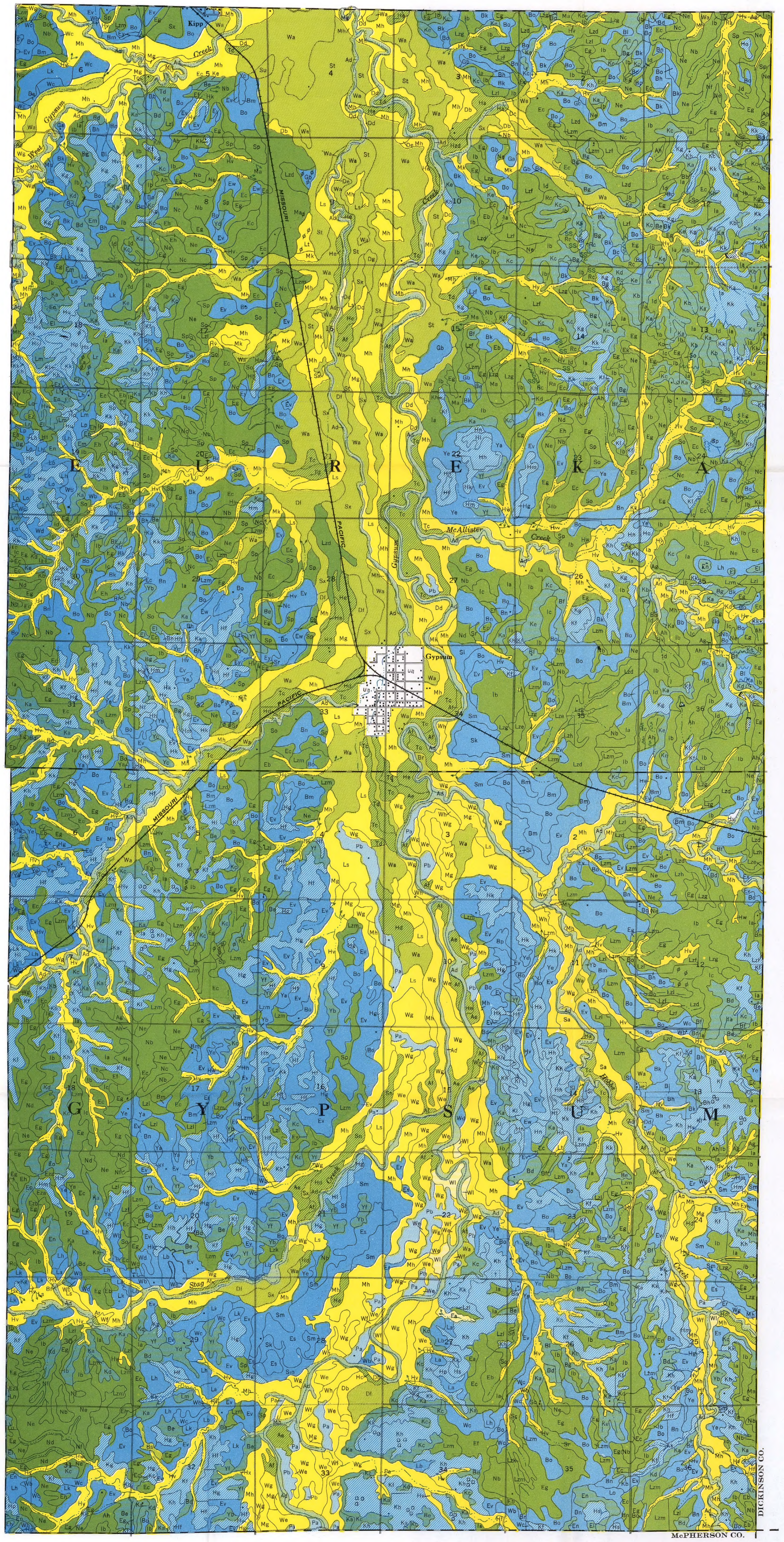
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
SALINE COUNTY - KANSAS
SHEET NO. 6

KANSAS AGRICULTURAL EXPERIMENT STATION



COLOR GROUPING

SHALLOW UPLAND SOILS

Albion coarse sandy loam, shallow phase, 2-6 percent slopes
Carlson silty clay loam, 2-6 percent slopes
Carlson silty clay loam, 6-12 percent slopes
Cloud silty clay loam, 2-6 percent slopes
Cloud silty clay loam, 6-12 percent slopes
Cloud silty clay loam, 6-12 percent slopes, severely eroded
Englund silty clay loam, very shallow variant, 2-6 percent slopes
Hallville loam, 2-6 percent slopes
Hallville loam, 2-6 percent slopes, eroded
Hallville loam, 6-12 percent slopes
Hallville loam, 6-12 percent slopes, severely eroded
Hallville loam, shallow phase, 2-6 percent slopes
Hallville loam, shallow phase, 2-6 percent slopes, severely eroded
Hallville loam, shallow ohase, 6-12 percent slopes
Hallville loam, shallow phase, 6-12 percent slopes, severely eroded
Hedville loam, 2-6 percent slopes
Hedville loam, 2-6 percent slopes, eroded
Hedville loam, 6-12 percent slopes
Hedville stony loam, 2-6 percent slopes
Hedville stony loam, 6-12 percent slopes
Kipson shaly silt loam, 2-6 percent slopes, eroded
Kipson shaly silt loam, 6-12 percent slopes, severely eroded
Kipson silt loam, 2-6 percent slopes
Kipson silt loam, 6-12 percent slopes
Kipson silt loam, over 12 percent slopes
Vernon silty clay loam, 2-6 percent slopes
Vernon silty clay loam, 2-6 percent slopes, severely eroded
Vernon silty clay loam, 6-12 percent slopes

MODERATELY DEEP UPLAND SOILS

Benfield silty clay loam, shallow phase, 2-6 percent slopes
Benfield silty clay loam, shallow phase, 2-6 percent slopes, eroded
Benfield silty clay loam, shallow phase, 2-6 percent slopes, severely eroded
Benfield silty clay loam, shallow phase, 6-12 percent slopes, severely eroded
Edalgo silt loam, 2-6 percent slopes
Edalgo silt loam, 2-6 percent slopes, eroded
Edalgo silt loam, 6-12 percent slopes
Edalgo silt loam, 2-6 percent slopes, severely eroded
Edalgo silt loam, 6-12 percent slopes, severely eroded
Kipp silt loam, 2-6 percent slopes
Kipp silt loam, 6-12 percent slopes
Kipp silty clay loam, 2-6 percent slopes, eroded
Kipp silty clay loam, 2-6 percent slopes, severely eroded
Kipp silty clay loam, 6-12 percent slopes, severely eroded
Lancaster fine sandy loam, shallow phase, 2-6 percent slopes
Lancaster fine sandy loam, shallow phase, 2-6 percent slopes, eroded
Lancaster fine sandy loam, shallow phase, 6-12 percent slopes
Lancaster loam, shallow phase, 2-6 percent slopes
Lancaster loam, shallow phase, 2-6 percent slopes, eroded
Lancaster loam, shallow phase, 6-12 percent slopes
Lanham silt loam, 2-6 percent slopes
Lanham silt loam, 2-6 percent slopes, severely eroded
Lanham silt loam, 6-12 percent slopes
Rentide silt loam, moderately shallow phase, 2-6 percent slopes
Yordy loam, shallow phase, 2-6 percent slopes
Yordy loam, shallow phase, 6-12 percent slopes
Yordy silty clay loam, shallow phase, 2-6 percent slopes, eroded

DEEP FRIABLE LOAMY UPLAND SOILS

Benfield silty clay loam, 2-6 percent slopes
Benfield silty clay loam, 2-6 percent slopes, eroded
Benfield silty clay loam, 2-6 percent slopes, severely eroded
Berg silt loam, 0-2 percent slopes
Berg silt loam, 2-6 percent slopes
Berg silty clay loam, 2-6 percent slopes, eroded
Berg silty clay loam, 2-6 percent slopes, severely eroded
Elmo loam, terrace phase, 2-6 percent slopes
Elmo loam, terrace phase, 2-6 percent slopes, eroded
Elmo silt loam, terrace phase, 0-4 percent slopes
Elmo silt loam, terrace phase, 0-4 percent slopes, eroded
Elmo silt loam, 2-6 percent slopes
Elmo silt loam, 6-12 percent slopes
Elmo silty clay loam, 2-6 percent slopes, severely eroded
Elmo silty clay loam, 6-12 percent slopes, severely eroded
Geary silt loam, 2-6 percent slopes
Geary silt loam, 2-6 percent slopes, eroded
Geary silt loam, 6-12 percent slopes
Geary silt loam, 6-12 percent slopes, severely eroded
Lancaster fine sandy loam, 2-6 percent slopes
Lancaster fine sandy loam, 2-6 percent slopes, eroded
Lancaster fine sandy loam, 2-6 percent slopes, severely eroded
Lancaster fine sandy loam, 6-12 percent slopes
Lancaster loam, 2-6 percent slopes
Lancaster loam, 2-6 percent slopes, eroded
Lancaster loam, 2-6 percent slopes, severely eroded
Lancaster loam, 6-12 percent slopes
Lancaster loam, 6-12 percent slopes, severely eroded
Ninnescah silt loam, 0-2 percent slopes
Ninnescah silt loam, 2-6 percent slopes
Shellabarger fine sandy loam, 2-6 percent slopes
Shellabarger fine sandy loam, 2-6 percent slopes, eroded
Shellabarger fine sandy loam, 2-6 percent slopes, severely eroded
Shellabarger loam, 2-6 percent slopes
Shellabarger loam, 2-6 percent slopes, eroded
Shellabarger loam, 2-6 percent slopes, severely eroded
Shellabarger loam, 6-12 percent slopes, eroded
Shellabarger silt loam, 0-2 percent slopes
Shellabarger silt loam, 2-6 percent slopes
Shellabarger silt loam, 2-6 percent slopes, eroded
Westfall silt loam, 2-6 percent slopes
Westfall silty clay loam, 2-6 percent slopes, eroded
Westfall silty clay loam, 2-6 percent slopes, severely eroded
Yordy loam, 2-6 percent slopes
Yordy loam, 6-12 percent slopes
Yordy silty clay loam, 2-6 percent slopes, eroded

DEEP LOAMY UPLAND SOILS WITH COMPACT SUBSTRATA

Assaria silt loam, 2-6 percent slopes
Assaria silty clay loam, 2-6 percent slopes, eroded
Ebenezer loam, 2-6 percent slopes
Ebenezer silt loam, 0-2 percent slopes
Ebenezer silt loam, 2-6 percent slopes
Ebenezer silt loam, colluvial phase, 2-6 percent slopes
Ebenezer silt loam, colluvial phase, 2-6 percent slopes, eroded
Ebenezer silty clay loam, 0-2 percent slopes, eroded
Ebenezer silty clay loam, 2-6 percent slopes, eroded
Ebenezer silty clay loam, 2-6 percent slopes, severely eroded
Ebenezer silty clay loam, 6-12 percent slopes, eroded
Englund silt loam, 2-6 percent slopes
Englund silt loam, 2-6 percent slopes, eroded
Englund silt loam, 2-6 percent slopes, severely eroded
Idana silt loam, 2-6 percent slopes
Idana silt loam, 2-6 percent slopes, eroded
Idana silty clay loam, 2-6 percent slopes, severely eroded
Idana silty clay loam, 6-12 percent slopes, eroded
Lockhard loamy fine sand, overblown phase, 2-6 percent slopes
Lockhard silt loam, 0-2 percent slopes
Lockhard silt loam, 0-2 percent slopes, eroded
Lockhard silt loam, 2-6 percent slopes
Lockhard silt loam, 2-6 percent slopes, eroded
Lockhard silt loam, 2-6 percent slopes, severely eroded
Longford silt loam, 0-2 percent slopes
Longford silt loam, 2-6 percent slopes
Longford silty clay loam, 2-6 percent slopes, eroded
McPherson silt loam, 0-3 percent slopes
Malmgren silt loam, 0-2 percent slopes
Malmgren silt loam, 2-6 percent slopes
Niles silt loam, 0-2 percent slopes
Niles silt loam, 2-6 percent slopes
Niles silt loam, 2-6 percent slopes, severely eroded
Niles silty clay loam, 0-2 percent slopes, eroded
Niles silty clay loam, 2-6 percent slopes, eroded
Niles silty clay loam, 2-6 percent slopes, severely eroded
Rentide silt loam, 2-6 percent slopes
Rentide silty clay loam, 2-6 percent slopes, eroded
Smolan silt loam, 2-6 percent slopes
Smolan silt loam, 2-6 percent slopes, eroded
Smolan silt loam, 2-6 percent slopes, severely eroded
Tescott silt loam, 2-6 percent slopes
Tescott silty clay loam, 2-6 percent slopes, eroded

DEEP MODERATELY COARSE-TEXTURED UPLAND SOILS

Pratt fine sandy loam, 2-6 percent slopes
Pratt fine sandy loam, 2-6 percent slopes, eroded

SOILS MAINLY FROM COARSE-TEXTURED ALLUVIUM

Albion loam, 2-6 percent slopes
Albion loam, 6-12 percent slopes
Detroit loamy very fine sand, overwash phase, 0-2 percent slopes
Falun fine sandy loam, 0-2 percent slopes
Falun fine sandy loam, 2-6 percent slopes
Lincoln loamy fine sand, 0-2 percent slopes
Lincoln loamy fine sand, 2-6 percent slopes
Windom loamy fine sand, sandy substratum variant, 0-2 percent slopes
Windom loamy fine sand, sandy substratum variant, 2-6 percent slopes

SOILS MAINLY FROM MEDIUM-TEXTURED ALLUVIUM

Arkansas fine sandy loam, 0-2 percent slopes
Arkansas fine sandy loam, 2-6 percent slopes
Hall silt loam, 0-2 percent slopes
Hall silt loam, 2-6 percent slopes
Hall silt loam, 2-6 percent slopes, eroded
Hall silt loam, brown subsoil variant, 0-2 percent slopes
Hall silt loam, brown subsoil variant, 2-6 percent slopes
Humbarger loam, 0-2 percent slopes
Humbarger loam, 2-6 percent slopes
Humbarger loam, 2-6 percent slopes, eroded
Humbarger silt loam, 0-2 percent slopes
Humbarger silt loam, 2-6 percent slopes
Humbarger silt loam, 2-6 percent slopes, eroded
Humbarger silt loam, 2-6 percent slopes, severely eroded
Smoky Butte silt loam, 0-2 percent slopes
Tobin silt loam, 0-2 percent slopes
Tobin silt loam, 2-6 percent slopes

SOILS MAINLY FROM MODERATELY FINE-TEXTURED ALLUVIUM

Detroit silt loam, 0-2 percent slopes
Detroit silt loam, 2-6 percent slopes
Detroit silt loam, overwash phase, 0-2 percent slopes
Detroit silt loam, overwash phase, 2-6 percent slopes
Fore silty clay loam, deep over silt, 0-2 percent slopes
Fore silty clay loam, deep over silt, 2-6 percent slopes
Hobbs silt loam, 0-2 percent slopes
Hobbs silt loam, 0-2 percent slopes, eroded
Hobbs silt loam, 2-6 percent slopes
Hobbs silt loam, 2-6 percent slopes, eroded
Hobbs silt loam, light colored variant, 0-2 percent slopes
Langley silt loam, 0-2 percent slopes
Langley silt loam, 2-6 percent slopes
Langley silty clay loam, 2-6 percent slopes, eroded
Marydel fine sandy loam, 0-2 percent slopes
Marydel silt loam, 0-2 percent slopes
Marydel loam, poorly drained variant, 0-2 percent slopes
Marydel loamy fine sand, 0-2 percent slopes
Muir silt loam, 0-2 percent slopes
Muir silt loam, 2-6 percent slopes
Salemburg silt loam, 0-2 percent slopes
Windom fine sandy loam, 0-2 percent slopes
Windom fine sandy loam, 2-6 percent slopes
Windom loam, 0-2 percent slopes
Windom loam, 2-6 percent slopes

SOILS MAINLY FROM FINE-TEXTURED ALLUVIUM

Bonaccord silty clay loam, 0-2 percent slopes
Bonaccord silty clay loam, 2-6 percent slopes
Bonaccord silty clay loam, 2-6 percent slopes, eroded
Bonaccord silty clay loam - Salonetz complex, 0-2 percent slopes
Detroit silty clay loam, 0-2 percent slopes
Detroit silty clay loam, 2-6 percent slopes
Detroit silty clay loam, 2-6 percent slopes, eroded
Fore clay, 0-2 percent slopes
Fore clay, 2-6 percent slopes
Langley silt loam - Solonetz complex, 0-2 percent slopes
Lindsborg silt loam, 0-2 percent slopes
New Cambria silty clay loam, 0-2 percent slopes
Rokeby silt loam, 0-2 percent slopes
Roxbury silty clay loam, 0-2 percent slopes
Roxbury silty clay loam, 2-6 percent slopes, eroded
Solomon clay, 0-2 percent slopes
Solomon clay, low lime variant, 0-2 percent slopes
Stimmel silt loam, 0-2 percent slopes
Stimmel silt loam, 2-6 percent slopes
Stimmel silty clay loam, 2-6 percent slopes, severely eroded
Sutphen silty clay, 0-2 percent slopes
Wabash silty clay loam, 0-2 percent slopes

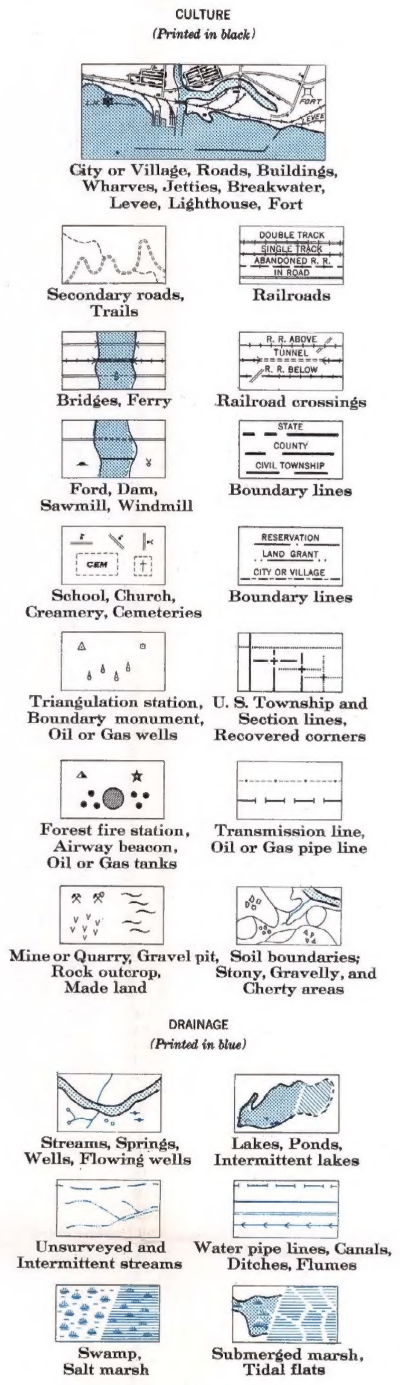
MISCELLANEOUS LAND TYPES

Alluvial land
Made land, 0-2 percent slopes
Rough broken and Rough stony land, Vernon and Hedville soil materials

SPECIAL SYMBOLS

	Solonetz spot
NA	Nonagricultural land
S	Moderate erosion
SS	Severe erosion
	Gully, unclassified

CONVENTIONAL SIGNS



The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Soils surveyed 1946-49 by A. J. Cline, in Charge, James T. Neill, and Orville W. Saffry, Soil Conservation Service, and Paul L. Brown and Darold A. Dodge, Kansas Agricultural Experiment Station. Inspection and Correlation by William M. Johnson, Soil Conservation Service.

Scale 1:31,680

1 ½ 0 1 2 Miles

5 000 0 5 000 10 000 Feet

SHEET INDEX

1	2	3
4	5	6

Map constructed by Cartographic Division, Soil Conservation Service, USDA, from 1938 aerial photographs.
Soils surveyed on 1938 aerial photographs.
Polyconic projection, 1927 North American datum.
10000-foot grid based on Kansas (North) rectangular coordinate system.